

## CHAPTER 7: SUBWATERSHED RESTORATION STRATEGIES

Restoration strategies for each subwatershed are presented in the following subsections. A description of key watershed characteristics is presented for each subwatershed including drainage area, stream length, population, land use/land cover, impervious cover, soils, and stormwater control measures (SCMs). Assessment results for neighborhoods, hotspots, institutions, pervious areas, stream corridors (including potential stream restoration and preservation sites), and stormwater conversions are also summarized for each subwatershed. Lastly, a subwatershed management strategy including recommended citizen and municipal actions is presented at the end of each subsection.

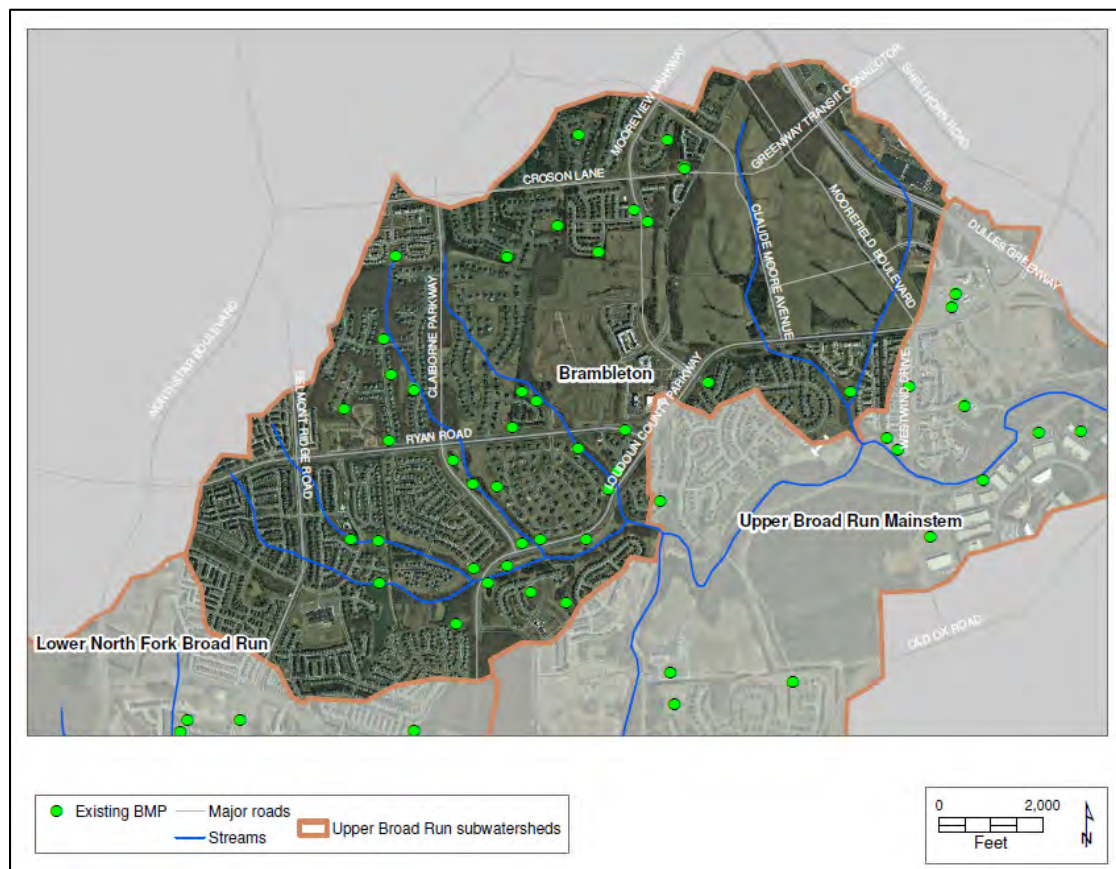
### 7.1 Brambleton

Brambleton is the third largest subwatershed in the Upper Broad Run watershed. It is the most densely populated (see Figure 3-9) and has the highest percentage of impervious cover (21.6%), according to data available based on spring 2012 aerial imagery. Several of the large HOAs present in the Upper Broad Run watershed have multiple communities located within this subwatershed, which is why the majority of the Neighborhood Source Assessments were conducted here. Figure 7-1 shows the existing conditions (as of 2012) within the subwatershed. Table 7-1 summarizes the key characteristics of Brambleton subwatershed.

**Table 7-1: Key Characteristics - Brambleton Subwatershed**

Drainage Area	2,335.1 acres (3.6 sq. mi.)	
Stream Length	8.0 miles	
Land Use/Land Cover	Barren:	0.3%
	Cropland:	13.7%
	Forest:	16.2%
	Pasture:	4.4%
	Urban Impervious:	20.6%
	Urban Pervious:	43.1%
	Water:	1.3%
	Missing:	0.4%
Impervious Cover	504.0 acres (21.6%)	
Soils	A Soils (low runoff potential):	0%
	B Soils:	2.1%
	C Soils:	30.6%
	D Soils (high runoff potential):	63.6%
	*B/D Soils:	2.3%
	*C/D Soils:	1.4%
SCMs	43.8% of subwatershed treated	

\*Dual Hydrologic Soil Group. See Chapter 3 for further detail.



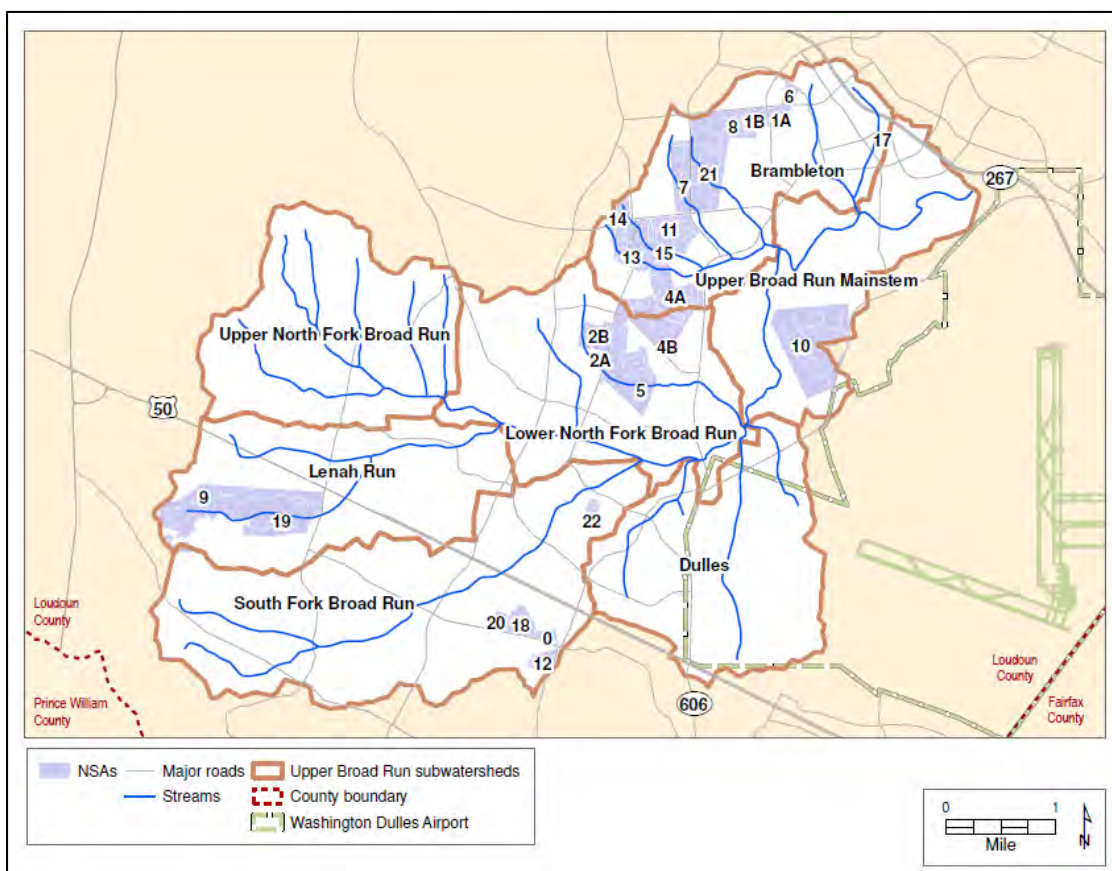
**Figure 7-1: Existing Conditions - Brambleton Subwatershed (Spring 2012 aerial imagery provided by Loudoun County)**

### *Neighborhoods*

A total of 13 distinct neighborhoods were identified and assessed within the Brambleton subwatershed during the uplands assessment of the Upper Broad Run watershed. Preliminary recommendations for neighborhoods in this subwatershed included actions to reduce stormwater volume and pollutants including downspout disconnection, use of rain barrels, installation of rain gardens, conservation planting, storm drain marking, fertilizer reduction, stream buffer improvements, new SCMs, and tree planting. A map that shows the location of each neighborhood assessed along with their Site IDs is presented in Figure 7-2. A summary of preliminary neighborhood recommended actions for the Brambleton subwatershed is presented in Table 7-2.

**Table 7-2: Neighborhood Source Assessment (NSA) Recommendations – Brambleton**

PRELIMINARY RECOMMENDED ACTIONS													
Site ID	Lot Size (acres)	%Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Conservation Planting	Increase Lot Canopy	Pet Waste	Fertilizer Reduction	Buffer Improvement	New SCM	# of Open Space Trees	Notes
NSA-1A	N/A	10			✓		✓						
NSA-1B	1/4	22			✓		✓				✓	170	Rain gardens can be installed around yard drains in common area.
NSA-4A	< 1/4	25					✓	✓			✓		
NSA-6	N/A	50	✓		✓		✓						
NSA-7	1/2	75	✓		✓	✓			✓	✓			One of the few neighborhoods assessed that has several lots with a high percentage of tree canopy.
NSA-8	1/2	50		✓		✓	✓		✓				
NSA-11	1/4	15			✓	✓	✓						
NSA-13	< 1/4	20					✓				✓		Clean neighborhood that has done a great job of reducing its stormwater runoff footprint.
NSA-14	N/A	20			✓		✓						
NSA-15	<1/4	40	✓				✓				✓		Large area behind houses contains scattered boulders and yard drains. Could be a good area for bioretention.
NSA-16	N/A	10					✓						A few tree box filters intercept some of the parking lot runoff near common area. SCM pond located on southwest side of neighborhood.
NSA-17	N/A	100	✓				✓	✓					A large portion of the downspouts drain to pervious strips that are less than 15 feet long and likely do not allow for much infiltration.
NSA-21	1/2	22				✓	✓		✓	✓		1,552	Large amount of open space. Good tree planting candidate.



**Figure 7-2: Location and Site IDs of Neighborhood Source Assessment (NSA) Areas in Upper Broad Run Watershed**

All of the neighborhoods assessed within the Brambleton subwatershed had opportunities for improvement. Storm drain marking (Figure 7-3), rain barrels, conservation planting, and new SCMs were widely recommended. Storm drain marking is popular because this relatively easy and inexpensive action can have a great effect by reminding residents not to dump potentially dangerous materials into the storm drain. It can also be easily paired with other education efforts, for example, with education regarding the effects of pet waste on water quality, in neighborhoods where both were recommended. Rain barrels serve as temporary storage of roof runoff, decreasing the volume of stormwater running off site, but also do a great job of promoting stormwater runoff awareness. NSA-21 has a large amount of open space in several portions of the neighborhood and is considered a great site for a tree planting project (Figure 7-4). NSA-1B, NSA-4A, NSA-13, and NSA-15 are good sites for bioretention area/rain garden installation projects. Projects on this scale may encourage widespread community engagement and are ideal opportunities for children and families to become involved with their watershed in a concrete way. In addition, actions as simple as adjusting mowing practices and tree plantings along stream channels and drainage ditches may help to slow down high stream flows that cause bank erosion and to intercept nutrients and toxins before they enter the aquatic ecosystem.



**Figure 7-3: Unmarked Storm Drain in Brambleton Neighborhood**



**Figure 7-4: Tree Planting Opportunity at NSA-21**

### ***Hotspots***

One site was inspected in the Brambleton subwatershed, consisting of a shopping center. The site included a multi-story building containing small shops and businesses, a standalone supermarket, and a building of storefront businesses with residences above. The shopping area had not completed construction and several vacant parcels were noted. The buildings were assessed in aggregate as one site. A summary of field findings and preliminary recommended actions is presented in Table 7-3.

**Table 7-3: Hotspot Site Investigation (HSI) Results and Recommendations – Brambleton**

Site ID	Active Pollution Observed			Recommended Follow-up Actions			Hotspot Status			
	Vehicle Operations	Outdoor Materials	Physical Plant	Refer for Enforcement	Follow Up Inspection	Include in Future Education	Not	Potential	Confirmed	Severe
HSI-001								✓		

Note: No active pollution observed or follow-up actions recommended for this subwatershed.

At the supermarket, signs of leakage into a storm drain inlet were found behind the building. Near the two-story miscellaneous business building, a dumpster was found near a storm drain inlet, though it was not leaking (Figure 7-5). The dumpster had been placed outside of the dumpster stall; neither area had secondary containment. For this site, a more judicious placement of the dumpsters away from the storm drain inlet, and adding secondary containment, would reduce the chances of direct input of pollution from dumpsters to the storm sewer system.



**Figure 7-5: Leaking Compactor (left) and Dumpster (right) Situated Near Storm Drain Inlets at HSI-001**

### *Institutions*

Two elementary schools were investigated in Brambleton subwatershed. A summary of potential opportunities for restoration at each are presented in Table 7-4.

Opportunities to provide demonstration projects and real-world examples of watershed restoration are plentiful at Legacy Elementary School. Visible tree planting areas are readily available in the grassy lawn areas on the northwest corner of the property and along Legacy Park Drive. The former area is already planted, but could easily be amended to create a dense wooded canopy to

benefit stormwater infiltration, parcel cooling, and extension of wooded areas in the neighborhood to the east of the school property. Other available areas on the school property include the bus turnaround drive and small areas near impervious parking areas. SCMs that would infiltrate and treat sheetflow runoff from playground areas behind the school consist of bioretention and berms. Field staff noted an erosion problem developing near a yard drain and down-gradient of a culvert underneath footpaths (Figure 7-6). Bioretention would remediate sediment transport to the storm drain system from these eroded areas. An additional eroded area at the edge of the athletic track would benefit from installation of terraces. An exercise that would create an enthusiastic response from children is storm drain stenciling. Lastly, a problem with dumpster leachate that was noted by field staff could be addressed by waste management training. A barrel of possible waste cooking oil stored outside in the dumpster stalls was found loosely sealed, which may cause a pollution problem when exposed to precipitation.

**Table 7-4: Institutional Site Investigation (ISI) Recommendations – Brambleton**

PRELIMINARY RECOMMENDED ACTIONS									
Site ID	Name	Storm Drain Marking	# Trees for Planting	Downspout Disconnection	New SCM	Impervious Cover Removal	Buffer Improvement	Trash Management	Notes
ISI-004	Legacy Elementary School	✓	285		✓			✓	Staff says areas are reseeded but seed washes off
ISI-005	Moorefield Station Elementary School		See PAA		✓		✓		Overall clean site, as expected of a new school



**Figure 7-6: Terracing Opportunity to Address Erosion (left) and Stains Leading from Dumpster to Storm Drain Inlet (right) at Legacy Elementary School**

Moorefield Station Elementary School is a recently constructed school in the Brambleton subwatershed. New environmental education initiatives could include activities such as tree planting to improve forest cover and stream buffer sizes. Field staff noted buffer encroachment issues at both the front (east) and rear (west) property lines (Figure 7-7). The school is maintaining portions of these areas as meadows; however, the planting of trees would improve stormwater infiltration and stream buffer character even more. For stormwater management, the school features level spreading and infiltration. To augment treatment, bioretention can be installed in areas where grassy swales currently handle stormwater runoff from impervious areas, particularly playground areas to the rear and to the north of the school building. These demonstration projects would be just steps away from the school doors and provide a valuable connection between human activities and stormwater quality and what steps can be taken to improve instream conditions.



**Figure 7-7: Opportunities for Stream Buffer Augmentation (left) and Bioretention (right) at Moorefield Station Elementary School**

### *Pervious Areas*

Pervious area restoration has the potential to convert areas of turf and other maintained cover, which often have high nutrient inputs to forest, which can absorb and filter rather than contribute nutrients. Two pervious areas were assessed for restoration potential in the Brambleton Branch of Broad Run; Loudoun Valley Estates - West and Moorefield Station Elementary School. The **Loudoun Valley Villages - West** site is located off Zion Chapel Drive, near its intersection with North Brown Square. The site is privately-owned by the HOA. The site possesses several long, narrow potential tree planting areas bordering a perennial tributary and associated nontidal wetlands; it is a green space essentially surrounded by residences. The planting area is easily accessed, and could be planted with minimal site preparation. A large part of the site currently possesses maintained turf (70%). Benefits of tree planting here would include slowing of surface flow runoff to the adjacent stream corridor and wetlands. The **Moorefield Station Elementary School** site is located off Mooreview Parkway, north of Clarendon Square. The site is publicly-owned, and would be a good candidate for tree planting with minimal site preparation. Only a small portion of the site (5%) currently possesses maintained turf (close to the school); other

parts of the site consist of upland meadow and shrub/scrub (former pastured land), and deciduous forest. One small area to the immediate south of the school possesses scattered mature trees (primarily oaks); this area would greatly benefit from allowing it to re-generate naturally (i.e., no mowing) with greater numbers of small trees and shrubs. The deciduous forested areas in the eastern and the western parts of the site both contain perennial stream corridors and nontidal wetlands. Benefits of tree planting along the outer edges of these areas would definitely include the slowing of surface flow runoff to the adjacent stream corridors, as well as enhancing protections for the stream buffers and wetlands.

A summary of these sites is provided in Table 7-5.

**Table 7-5: Pervious Area Assessment Summaries – Brambleton**

Site ID	Location in Sub-watershed	Description	Acres	Ownership
Loudoun Valley Villages - West	North-central	Private Open Space	Parcel – N/A Recommended planting – 4.38	Private
Moorefield Station Elementary School	Southwest	County School	Parcel – 81.90 Recommended planting – 11.14	Public

### ***Stream Corridor Assessments***

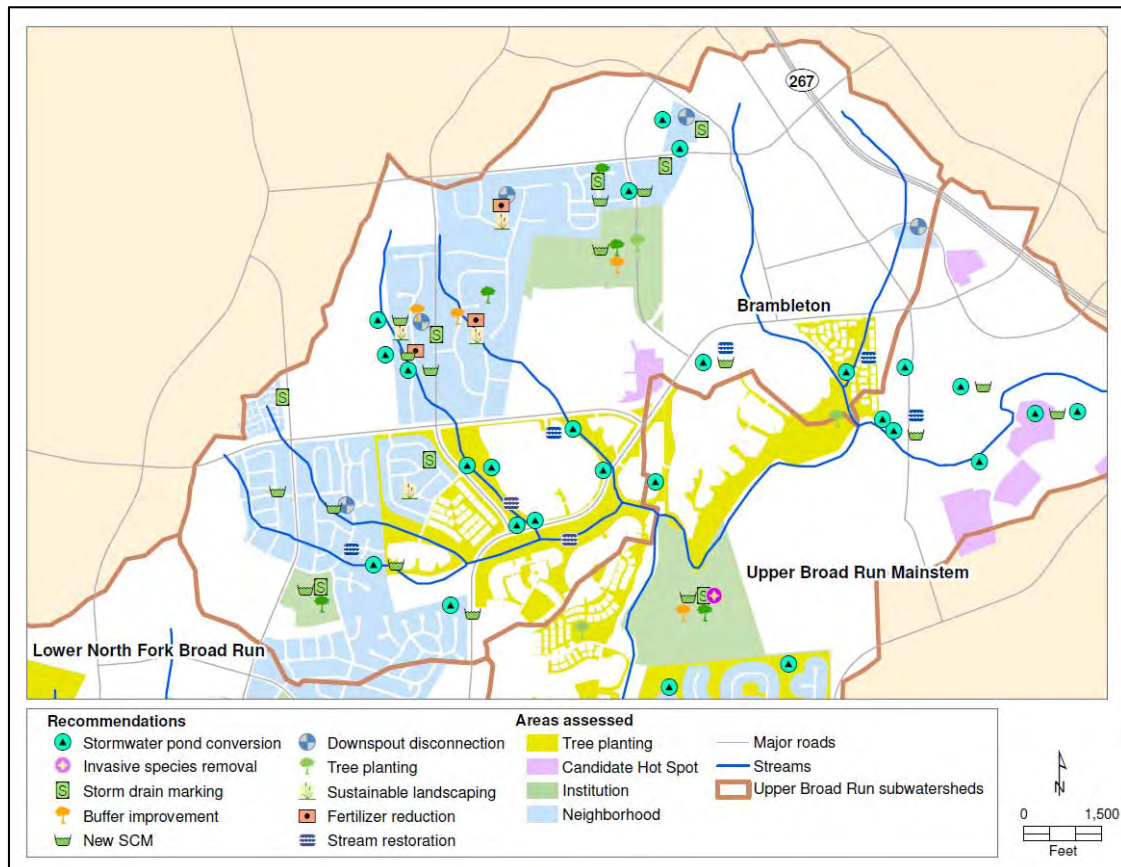
Field crews walked 1.02 miles of stream (12.7% of total stream miles) within the Brambleton subwatershed to identify potential water quality problems, restoration opportunities, and stream corridor preservation opportunities. This survey focused on first through second order stream reaches. A total of 18 problems were identified throughout the Brambleton subwatershed. The predominant issues were erosion (generally rated overall as low to moderate) and inadequate buffer (generally rated overall as moderate, with one severe point near the center of the reach). An exposed pipe was observed in the eastern-most part of the reach assessed, at an open area along the stream. The observed pipe was a 6-inch plastic sewer line that crosses the stream perpendicularly at this location. This sewer line should be fixed and re-set at the required depth under the stream bed, preferably through use of horizontal directional drill (HDD) technology. All necessary nontidal wetlands and other permits would need to be secured from Virginia DEQ (and possibly other regulatory agencies) prior to initiating the work. Additionally, native trees and shrubs should be planted on the stream side of the Loudoun Water sewer line ROW where they would not interfere with operation and maintenance of the sewer line, and in other places near the center of the reach. These planted areas would enhance very inadequate stream buffers in several locations, and would provide positive benefits to the stream and wildlife. Maps showing key findings of the stream corridor assessments are found in Section 4.1.

### ***Stormwater Conversions***

A total of 16 existing stormwater management ponds in the Brambleton subwatershed were targeted for Retrofit Reconnaissance Investigations. The conversion feasibility, along with subsequent potential to improve water quality, was ranked for each facility. Of the 16 ponds, 2 were ranked as High, 2 as Medium, 7 as Low, 3 as Very Low, and 2 were not considered good candidates for conversions.

### ***Subwatershed Management Strategy***

Figure 7-8 provides a visual summary of potential restoration opportunities in the Brambleton subwatershed.



**Figure 7-8: Preliminary Restoration Opportunities in Brambleton Subwatershed**

### **Engaging Citizens and Watershed Groups**

1. Conduct appropriate downspout rain barrel and rain garden installation measures in neighborhoods according to Table 7-2.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 7-2.
3. Educate citizens about the benefits and importance of conservation planting and its effects on water quality for neighborhoods indicated in Table 7-2.
4. Educate property owners about improving stream buffer management at locations indicated in Table 7-2.
5. Educate property owners about the water quality benefits of reducing fertilizer use on lawns as indicated in Table 7-2.

6. Encourage communities to plant open space trees. Table 7-2 shows potential neighborhoods for planting as many as 1,722 open space trees.
7. Engage institutional sites listed in Table 7-4 in tree planting and new SCMs.
8. Investigate the pervious areas described in Table 7-5 for potential tree planting.

#### Municipal Actions

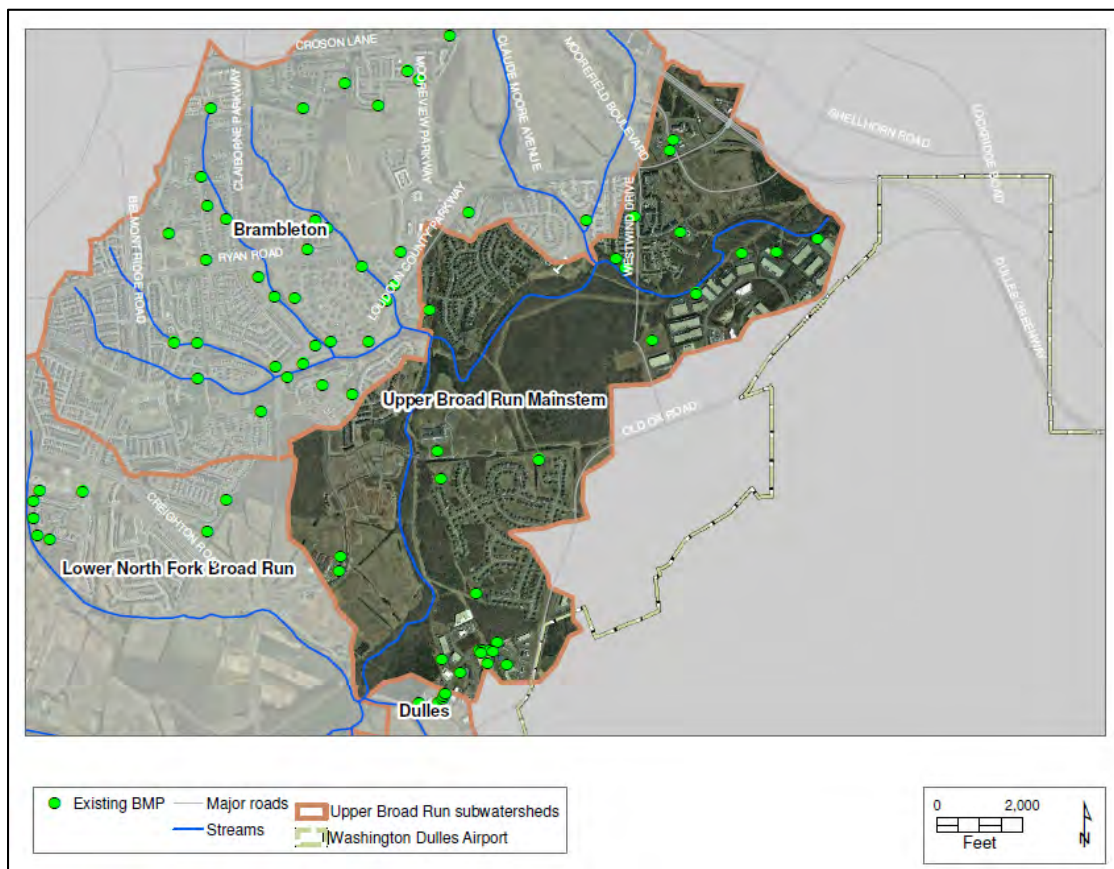
1. Continue to monitor conditions at potential hotspots indicated in Table 7-3.
2. Educate staff of Legacy Elementary School about the importance of proper trash management as listed in Table 7-4.
3. Consider re-setting the exposed sewer pipe noted during the SCA.
4. Consider preliminary recommendations for stream restoration in areas of moderate to severe bank erosion and channel alteration, as noted during the SCA.
5. Consider upgrading the stormwater management ponds described above that were ranked High or Medium for their potential conversion to improve water quality.

### **7.2 Upper Broad Run Mainstem**

Upper Broad Run Mainstem is the smallest subwatershed in the Upper Broad Run watershed. The main-stem of Broad Run is the only perennial stream within this subwatershed, and its furthest downstream point serves as the Upper Broad Run watershed outlet. It is the second most densely populated subwatershed and has the second highest amount of impervious cover (13.6%), according to data available based on spring 2012 aerial imagery. Upper Broad Run Mainstem is the location of two large business parks containing dozens of commercial facilities, many of which were visited for hotspot site investigations. Figure 7-9 shows the existing conditions (as of 2012) within the subwatershed. Table 7-6 summarizes the key subwatershed characteristics of Upper Broad Run Mainstem.

#### ***Neighborhoods***

One neighborhood was assessed within the Upper Broad Run Mainstem subwatershed during the uplands assessment of the Upper Broad Run watershed. Preliminary recommendations for the neighborhood in this subwatershed included actions to reduce stormwater volume and pollutants including downspout disconnection, installation of rain gardens, conservation planting, storm drain marking, stream buffer improvements, new SCMs, and tree planting. A summary of preliminary neighborhood recommended actions is presented in Table 7-7.



**Figure 7-9: Existing Conditions – Upper Broad Run Mainstem Subwatershed**

**Table 7-6: Key Characteristics – Upper Broad Run Mainstem Subwatershed**

Drainage Area	1,875.5 acres (2.9 sq. mi.)
Stream Length	4.4 miles
Land Use/Land Cover	<p>Barren: 0.3%</p> <p>Cropland: 6.3%</p> <p>Forest: 34.7%</p> <p>Pasture: 9.4%</p> <p>Urban Impervious: 15.7%</p> <p>Urban Pervious: 30.7%</p> <p>Water: 1.6%</p> <p>Missing: 1.3%</p>
Impervious Cover	317.2 acres (16.9%)
Soils	<p>A Soils (low runoff potential): 0%</p> <p>B Soils: 2.4%</p> <p>C Soils: 22.7%</p> <p>D Soils (high runoff potential): 62.2%</p>
	*B/D Soils: 9.2%
	*C/D Soils: 2.0%
SCMs	27.6% of subwatershed treated

\*Dual Hydrologic Soil Group. See Chapter 3 for further detail.

**Table 7-7: NSA Recommendations – Upper Broad Run Mainstem**

PRELIMINARY RECOMMENDED ACTIONS													
Site ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Conservation Planting	Increase Lot Canopy	Pet Waste	Fertilizer Reduction	Buffer Improvement	New SCM	# of Open Space Trees	Notes
NSA-10	1/2	50		✓	✓	✓	✓			✓	✓	702	Great bioretention area opportunity in common area. Good opportunity to enhance buffer around the ephemeral channel that carries stormwater offsite.

The neighborhood assessed within the Upper Broad Run Mainstem subwatershed had several opportunities for improvement. It was estimated that 50% of the downspouts within this neighborhood are directly or indirectly connected to the storm drain. The large portion of the neighborhood covered by mowed lawns provides a great opportunity for rain garden installation and conservation planting. Storm drain marking, which offers an opportunity to not only engage residents, but to serve as a visual reminder of the downstream effects of residents' actions, was also recommended for this neighborhood. A large amount of open space in common areas that is suitable for bioretention areas/rain gardens and tree planting was noted in several portions of the neighborhood (Figure 7-10). In addition, actions as simple as adjusting mowing practices and tree plantings along the ephemeral channel that carries stormwater offsite may help to slow down high flows that cause bank erosion and to intercept nutrients and toxins before they enter the aquatic ecosystem.



**Figure 7-10: Bioretention Opportunity (left) and Tree Planting Opportunity (right) Within NSA-10**

## Hotspots

Investigations were conducted in two business parks and an area near two hotels in Upper Broad Run Mainstem. Since the business parks contained a multiplicity of businesses and opportunities, each major building or business was given its own site ID to facilitate hotspot investigations and isolate problems. Field findings and preliminary recommendations are presented in Table 7-8.

**Table 7-8: HSI Results and Recommendations –  
Upper Broad Run Mainstem**

Site ID	Active Pollution Observed			Recommended Follow-up Actions			Hotspot Status			
	Vehicle Operations	Outdoor Materials	Physical Plant	Refer for Enforcement	Follow Up Inspection	Include in Future Education	Not	Potential	Confirmed	Severe
HSI-002					✓				✓	
HSI-003					✓			✓		
HSI-004									✓	
HSI-005							✓			
HSI-006					✓			✓		
HSI-007					✓			✓		
HSI-008					✓			✓		
HSI-009					✓			✓		
HSI-016					✓	✓			✓	
HSI-017					✓	✓				✓
HSI-018						✓		✓		

At Mercure Business Center and Dulles Trade Center, a preliminary field reconnaissance was performed to identify those buildings and businesses where issues were readily apparent. Special attention was paid to outdoor fueling, material storage, and housekeeping problems, especially if they were in the immediate vicinity of storm drain inlets.

At HSI-002, a number of housekeeping problems were apparent. Substantial inventory, stored material, and discarded material was placed out in the open on the rear parking lot. Materials included: floating barrels, concrete blocks, bundles of material, fencing, pallets, barrels, and scrap metal (Figure 7-11). Other items were stored inside and under trailers. Some material was stacked and placed near a storm drain inlet (Figure 7-12). For these storage problems, a network of canopy covers or hardened shelters would be highly beneficial and would reduce the likelihood of washing of pollutants to storm drain inlets.

Evidence of vehicle maintenance activities was inferred from the presence of at least one truck with an open hood. Fleet fueling operations without the benefit of a canopy was therefore noted. Two dumpsters were found onsite with tops open and with noticeable trash accumulation along a tree line behind the rear parking and inventory storage area. Recommended improvements to the site include the addition of sheltering structures for the fueling area, waste management training for employees, and movement of truck maintenance activity indoors as not to be exposed to precipitation.



**Figure 7-11: Piled up Pallets and Uncovered Fueling Station (left) and Storage of Material Under Trailer (right) at HSI-002**



**Figure 7-12: Inventory Stored Outside, on Impervious Surface, near Storm Drain Inlet (left) and Vehicle Maintenance Activity (right) at HSI-002**

The property housing HSI-003 straddles two watersheds. The northern half is in Upper Broad Run watershed; only the portion of the property contained within the Upper Broad Run watershed was assessed, with one exception: a dumpster was found open and adjacent to a storm drain inlet in an area outside of the Upper Broad Run watershed.

At another storm drain inlet, substantial gravel was found deposited near the opening, likely contributing to sediment transport to the storm drain system (Figure 7-13). The gravel appears to be tracked from a pervious storage yard, which contains inventory of cast iron, concrete, and plastic piping. In addition to the outside storage of inventory, one barrel of lacquer was noted in the rear parking lot, stored in the open. For this site, a sweeping plan is recommended to reduce tracking and transport of gravel material out of the yard and into the vicinity of the storm drain inlet. Secondary containment is recommended for liquid materials. Lastly, a network of canopies or hardened shelters is recommended to reduce the exposure of inventory items to precipitation.



**Figure 7-13: Storm Drain Inlet near Inventory Storage Area (left) and Outside Storage of Barrel of Lacquer (right) at HSI-003**

HSI-004 on Mercure Circle consists of two adjacent buildings. A large fueling station is situated between the buildings. The fuel tank appears to be double-walled to contain spills, but the overall fueling facility lacks a canopy that would reduce the risk of pollutants washing into a storm drain inlet during storms (Figure 7-14). A rollaway dumpster was noted on the site, which showed signs of leaking onto the impervious parking area between the buildings. Evidence of outdoor vehicle maintenance was also observed. Field staff also found a drum of liquid material resting on a pallet and a small number of bales of cardboard material stored outside. Given the facility's extensive building size, material could likely be stored inside and out of the reach of the erosive and leaching properties of rainfall. The pollution exposure profile could also benefit from modifying procedures to move servicing of vehicles indoors.



**Figure 7-14: Uncovered Fueling Station (left) and Rollaway Dumpster with Signs of Leakage (right) at HSI-004. Note that the liquid near the storm drain inlet (left) is melted snow.**

Multiple businesses are housed within HSI-007. A number of fleet vehicles were found onsite, along with a small fueling station. The fueling station, though small, lacked a canopy and would benefit from sequestration in a secondary containment area with proper sheltering (Figure 7-15). Also lacking protective awnings were the several loading docks noted onsite. A dumpster was found open and with evidence of past staining on the impervious surface. Employee training in the best practices of waste management would decrease the likelihood of transporting pollution to the stream network.



**Figure 7-15: Open Dumpster (left) with Signs of Staining and Uncovered Fueling Station (right) at HSI-007**

A construction staging area was found inside of Mercure Circle. The address of this parcel is unknown. Field staff found a number of construction vehicles (e.g., backhoe, pavement roller), trucks (e.g., semi-trailers, dump trucks), and other vehicles on the site. Staff also noted piles of boulders, gravel, exposed dirt, and piles of scrap metal (Figure 7-16). An employee mentioned to field personnel that the site was a construction area for a new building; however, staff did not see any silt fencing. Staff could not ascertain ownership or responsible parties for the staging area. For this site, super silt fencing is recommended if it is indeed an active construction area. If it is a staging area, proper sheltering of bulk material and stormwater controls appropriate to the site (e.g., sediment basin) are highly recommended.

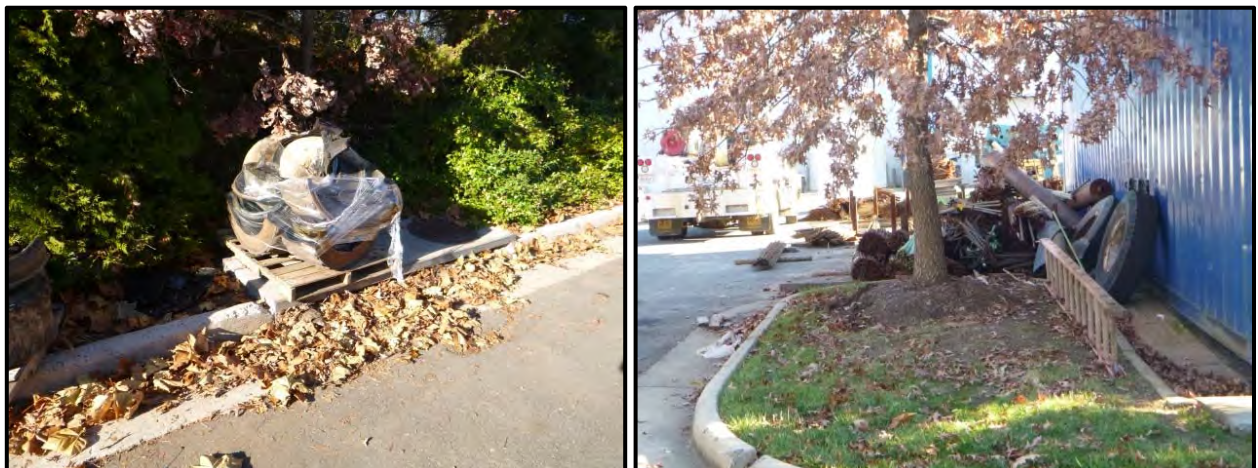
At HSI-009 on Mercure Circle, field staff identified a number of housekeeping problems in the rear lot. Storm drain inlets were found blocked by absorbent logs. In another area, bundles of used and broken up tire treads were found stacked along a gutter pan that led to a storm drain inlet (Figure 7-17). One bundle was found resting on top of a storm drain inlet (Figure 7-18). Junked or inoperable equipment was also found parked along the same gutter pan; a Bobcat had obvious oil staining underneath. Staff also identified a scrap metal pile on an impervious surface, a rollaway dumpster full of waste construction material, scrap metal bins and lumber and chain link fencing inventory stored in the open on impervious surfaces.



**Figure 7-16: Views of Gravel Piles (left) and Scrap Metal, Boulder Piles, and Construction Equipment at HSI-008**



**Figure 7-17: Junked Equipment and Tires Awaiting Disposal on Impervious Surface (left) and Blocked Storm Drain Inlets (right) at HSI-009**



**Figure 7-18: Tire Bundle Resting on Storm Drain Inlet (left) and Scrap Metal Pile on Impervious Surface (right) at HSI-009**

For inventory and equipment storage, especially on this impervious rear lot, canopies and shelters are recommended. Staff would also benefit from training on the proper storage of waste materials. Sediment and hydrocarbon runoff should be addressed with modifications to onsite procedures and not by relying on berms at storm drain inlet orifices. Increasing the frequency of inoperable equipment removal would also greatly benefit the site by removing pollution-causing materials from a direct route to storm drain inlets at this site.

Two hotels comprising HSI-005 were evaluated for hotspot status. Both hotels and their environs were found in good condition as they appeared to be newly constructed. Staff found that the only potentially pollution-causing conditions were the areas around the dumpster stalls (Figure 7-19). The dumpster at one of the hotels was found with a collapsed lid and was open to the elements. The dumpster stall for the other hotel had noticeable papers and pieces of discarded material strewn about on the inside. The staffs at both of these hotels would contribute to watershed stewardship by modifying waste management procedures and increasing their and their guests' awareness of their actions on the subwatershed.



**Figure 7-19: Loose Trash (left) and Damaged Dumpster (right) in Dumpster Stalls at HSI-005**

At a gas station and convenience store, Versar field staff identified waste management problems. Specifically, dumpsters in the designated stalls were found to be open or overflowing (Figure 7-20). Additionally, discarded bulk material, retail racks, a 55-gallon drum, and stacks of plastic product frames were found in the dumpster stall. All material was open to the elements which could potentially allow pollutants to be transported to a trench drain in close proximity to the stall. The trench storm drain immediately in front of the dumpsters was filled with enough material to allow grass to sprout. In a peripheral parking area near the gas pumps, staff found substantial staining of the asphalt, probably due to trucks and contractor vehicles visiting the convenience store. Versar recommends improvements in waste management procedures and training of staff so that accumulation of potentially pollution-causing material does not

accumulate or leach from the areas around the stalls. Maintenance on the trench drain would also remove another source of pollution to the stormwater network.



**Figure 7-20: Overflowing Dumpster (left) and Storage of Bulk Material (right) in the Open at HSI-006**

An auto body shop was one of many businesses visited within Dulles Business Center to assess for hotspot status. Field staff noted substantial repair and storage of automobiles outside and without the benefit of cover. Vehicles were being washed indoors; however, excess water was flowing out of the indoor areas and toward a storm drain inlet (Figure 7-21). Other materials, such as car parts and drums, were being stored likewise in the open, potentially creating a source of pollution to the storm sewer system. Dumpster stalls, and their immediate vicinity had collections of discarded material, car parts, and barrels placed nearby. For this site, a cleanup and assessment of storage procedures is recommended. The area and the subwatershed would benefit from modifications to waste management procedures including attention to placement of material into dumpsters and expeditious removal of discarded items such as car parts. A car wash capture system would also eliminate another source of direct input of pollution to the storm drain system.

At a vehicle maintenance business in Dulles Business Center, field staff identified several housekeeping issues in the back equipment lot. The company manages, stores, and repairs a fleet of vehicles and construction equipment and has a fueling station on the property. The fueling station does not have a canopy cover and is located within close proximity to a storm drain inlet (Figure 7-22). Staff also documented discarded material, such as an open bin of used tires. The rear lot also serves as a transfer area for dirt, gravel, and waste rubble, all of which is open to the elements and increases the storm drain system's and stream network's exposure to polluted and sediment-laden runoff (Figure 7-23). Other liquid material in barrels is stored outside without the benefit of secondary containment. Dumpsters placed near storm drain inlets were found to be overflowing.



**Figure 7-21: Excess Water from Washing Flowing Toward Storm Drain Inlet (left) and Discarded Material Near Dumpsters (right) at HSI-016**



**Figure 7-22: Uncovered Fueling Station (left) and Outdoor Storage of Discarded Tires (right) at HSI-017**



**Figure 7-23: Uncovered Piles of Dirt and Rubble (left) and Uncovered Equipment Storage Yard (right) at HSI-017**

The contribution by the business to polluted runoff could be reduced by placing material and conducting activities under canopy covers or shelters. Bulk waste, such as the bins of tires, should be removed quickly so that metals such as zinc are not accumulated and washed to the storm drain system. Bulk material, such as dirt, should be protected from the elements by using, at the very least, tarps. Training of employees, along with modification of waste management, equipment repair, and fueling procedures, would go a long way toward reducing this business' contribution of pollutant and sediment load to local streams.

Nearby, a construction company manages a large fleet, has outside fueling stations, stores liquid material outdoors without secondary containment, and places quantities of inventory and bulk material (dirt) on impervious surfaces, thus increasing the likelihood of polluted runoff entering the storm drain system. A rollaway dumpster was also found on the site. Field investigators found evidence of outside vehicle repair. Used tires and other discarded material were found stored outside in the open (Figure 7-24). Centralized areas where discarded material is collected should, at the very least, be underneath a canopy cover or placed into a warehouse. Liquid material should have secondary containment. Improvements to site operations should also include placing a canopy cover over outdoor fueling areas and conducting vehicle repair indoors or under an appropriate sheltering system. Lastly, staff should update their training of waste management procedures, so that excess material does not concentrate onsite where it can be transferred to streams.



**Figure 7-24: Outside Fueling Station and Outside Storage of Inventory (left); and Outside Vehicle Repair, Outside Liquid Material Storage, and Discarded Tires (right) at HSI-018**

## ***Institutions***

A middle school and elementary school were investigated in Upper Broad Run Mainstem sub-watershed. A summary of potential opportunities for restoration at each are presented in Table 7-9.

**Table 7-9: ISI Recommendations – Upper Broad Run Mainstem**

PRELIMINARY RECOMMENDED ACTIONS									
Site ID	Name	Storm Drain Marking	# Trees for Planting	Downspout Disconnection	New SCM	Impervious Cover Removal	Buffer Improvement	Trash Management	Notes
ISI-003	Stone Hill Middle School		567	✓	✓			✓	
ISI-009	Rosa Lee Carter Elementary School	✓	1,344		✓		✓	✓	Only assessed elementary school portion of property due to construction.

As is the case with all schools surveyed in the Upper Broad Run watershed, Stone Hill Middle School provides many opportunities for watershed restoration. Visibility of the watershed restoration measures is an added bonus since examples for environmental education are readily available. Adjacent to athletic fields are many opportunities for tree planting to convert unused or under-utilized grassy areas to forest canopy. Tree planting on the property would provide a much-needed contrast to the prevailing lack of trees in the immediate area. The property currently features bioretention areas adjacent to parking lots as pretreatment of stormwater. Stormwater treatment onsite could be further enhanced by installation of bioretention at strategic locations around the building and along a drainage swale between the back drive and the athletic fields. Bioretention servicing the faculty parking lot to the southwest could be expanded to infiltrate and treat a larger portion of the lot. This pretreatment reduces chemical and temperature pollution of stormwater effluent from the lot. Berms can be installed at the upstream end of the culvert that travels the width of the rear athletic area near the rear drive. These berms would capture and infiltrate sheetflow from athletic fields and points up-gradient. Lastly, the dry stormwater facility on the east side of the property can be converted to a wet pond to better settle out pollutants (Figure 7-25). Trash dumpsters located on the southwest portion of the school were found to be leaving stains on the impervious surface. Such staining is evidence of pollutants leaching from the dumpster and ultimately reaching storm drain inlets. A waste management training session for school staff would improve waste handling and reduce the possibility of pollution transport to the storm drain system.

At Rosa Lee Carter Elementary School, a large expanse of grass was found immediately in front of the school building and adjacent to Loudoun Reserve Drive (Figure 7-26). The grassy area provides an excellent opportunity for reforestation. A drainage swale that runs through the grassy zone could be converted to bioretention to provide an extra measure of stormwater treatment and

infiltration. A tree planting, outreach, and education effort could be undertaken to restore the buffer along Broad Run, which forms the western border of the school. Approximately 300 feet of buffer has been eliminated due to sanitary sewer line construction; areas outside of the sanitary sewer line easement can be planted. Other areas near ballfields could also be planted with trees to extend the buffer. Waste management could also be improved through staff training. On the east side of the school, a dumpster was found to be leaking contents onto the impervious surface in near proximity to a storm drain inlet. Additionally, a waste cooking oil drum was found loosely capped and with rain water ponding on the lid. Implementation of restoration measures such as these will decrease the local stream's exposure to increased volumes of polluted stormwater effluent from the school and will establish the school as a positive example of environmental stewardship.



**Figure 7-25: Tree Planting (left) and Dry Pond Conversion (right) Opportunities at Stone Hill Middle School**



**Figure 7-26: Waste Management Issue (left) and Tree Planting Opportunity at Rosa Lee Carter Elementary School**

### ***Pervious Areas***

Pervious area restoration has the potential to convert areas of turf and other maintained cover, often with high nutrient inputs, to forest, which can absorb and filter rather than contribute nutrients. Four pervious areas were assessed for restoration potential in the Upper Broad Run Mainstem subwatershed of Upper Broad Run; these include Broad Run Stream Valley Park North; Broad Run Stream Valley Park South; Loudoun Valley Villages - East; and Lyndora Park.

The **Broad Run Stream Valley Park North** site is located directly west of Rosa Lee Carter Elementary School, along Upper Broad Run. It is a medium-sized publicly-owned park that is divided into north and south parcels, bisected by Loudoun Reserve Drive. The Park essentially comprises a narrow greenway along Broad Run. Much of this part of the Park is covered by maintained turf (75%). Several small, linear open areas along existing forest may be suitable for planting. Reforestation of the site would require verifying that planting would not interfere with the current uses of the Park. In addition, a Loudoun Water sewer line ROW would have to be avoided and access maintained. Tree planting here (in current turf areas) would buffer the existing forest and stream corridor, and would slow surface runoff.

The **Broad Run Stream Valley Park South** site is located immediately south of Loudoun Reserve Drive (across from Rosa Lee Carter ES), along Upper Broad Run. It is a medium-sized publicly-owned park that is divided into north and south parcels, bisected by Loudoun Reserve Drive. The Park essentially comprises a narrow greenway along Broad Run. None of this part of the Park is covered by maintained turf (0%). Several small, linear open areas along existing forest may be suitable for planting. Reforestation of the site would require verification, however, that it would not interfere with the current uses of the Park, and that tree planting could be a potential community project. In addition, a Loudoun Water sewer line ROW is located along parts of this site; tree plantings would have to be planted off this utility, and access must be maintained. Tree planting here would provide the opportunity to add to and buffer the existing forest and stream corridor, and would help to slow surface runoff.

The **Loudoun Valley Villages - East** site is located immediately southwest of Golden Bamboo Terrace, near the intersection of Sunbury Street and Loudoun Reserve Drive. It is privately owned and maintained, and is easily accessible by foot, vehicle, or heavy equipment. Opportunities for tree planting and re-forestation at this site are located along the periphery of an existing stormwater detention facility. The stormwater facility drains east to a small tributary that flows directly to Upper Broad Run. About thirty percent (30%) of the site is covered by maintained turf, and it receives full sun exposure. Slowing overland stormwater flows to this facility by establishing forested cover would help to improve water quality flowing to Upper Broad Run. Reforestation of the site would require verification that it would not interfere with the current use of the site and that tree planting could be a potential community project.

The **Lyndora Park** site is located off Lucketts Bridge Circle. It is publicly-owned and maintained, is easily accessible by foot, vehicle, or heavy equipment. About twenty percent (20%) of the site is covered by maintained turf, and it receives full sun exposure. The best areas for reforestation at the Park are along its southern and southeastern parts, where semi-fallow fields

(that appear to be currently mowed semi-annually) meet existing forest along Upper Broad Run. Forest re-establishment in these locations would help to buffer the existing stream and its wetlands, and would enhance the aesthetic beauty of the Park. Reforestation of the site, however, requires verification that tree planting would not interfere with any projected uses in current master planning for the Park, and that tree planting could be a potential community project. An existing multi-branched sewer line right-of-way in the central and eastern parts of the site would also have to be avoided, and access to it maintained.

A summary of these sites is provided in Table 7-10.

**Table 7-10: PAA Summaries – Upper Broad Run Mainstem**

Site ID	Location in Sub-watershed	Description	Acres	Ownership
Broad Run Stream Valley Park North	West	County Park	Parcel – 28.79 (combined) Recommended planting – 2.88	Public
Broad Run Stream Valley Park South	West	County Park	Parcel – 28.79 (combined) Recommended planting – 0.58	Public
Loudoun Valley Villages - East	West	Private Open Space	Parcel – N/A Recommended planting – 0.56	Private
Lyndora Park	Northwest	County Park	Parcel – 17.00 Recommended planting – 3.66	Public

### ***Stream Corridor Assessments***

Field crews walked 1.37 miles of stream (31.2% of total stream miles) within the Upper Broad Run Mainstem subwatershed to identify potential water quality problems, restoration opportunities, and stream corridor preservation opportunities. This survey focused on the main branch of Broad Run, which is a third order stream reach. A total of 11 problems were identified throughout the Upper Broad Run Mainstem subwatershed. The predominant issues were erosion (mostly rated as moderate in the eastern parts of the reach assessed), and inadequate buffer (generally rated as moderate to severe in the eastern parts of the reach assessed). Three utility rights-of-way were encountered along the assessed reach of Broad Run, including a Loudoun Water sewer ROW, a County water line ROW, and an electric transmission line ROW. Each of these ROWs contribute to degradation of the stream, owing to the inadequate stream buffers that exist (resulting in increased bank erosion and other problems), as well as occasional required access to the stream by maintenance vehicles. It is not clear, however, what, if anything, can be done at these locations to mitigate such conditions; the ROWs typically must be kept permanently clear of woody vegetation. Where possible, however, native trees and shrubs should be planted on the stream side of the ROW where they would not interfere with operation and maintenance of the sewer line. These planted areas would enhance very inadequate stream buffers in many locations, and would provide positive benefits to wildlife. Maps showing key findings of the stream corridor assessments are found in Section 4.1.

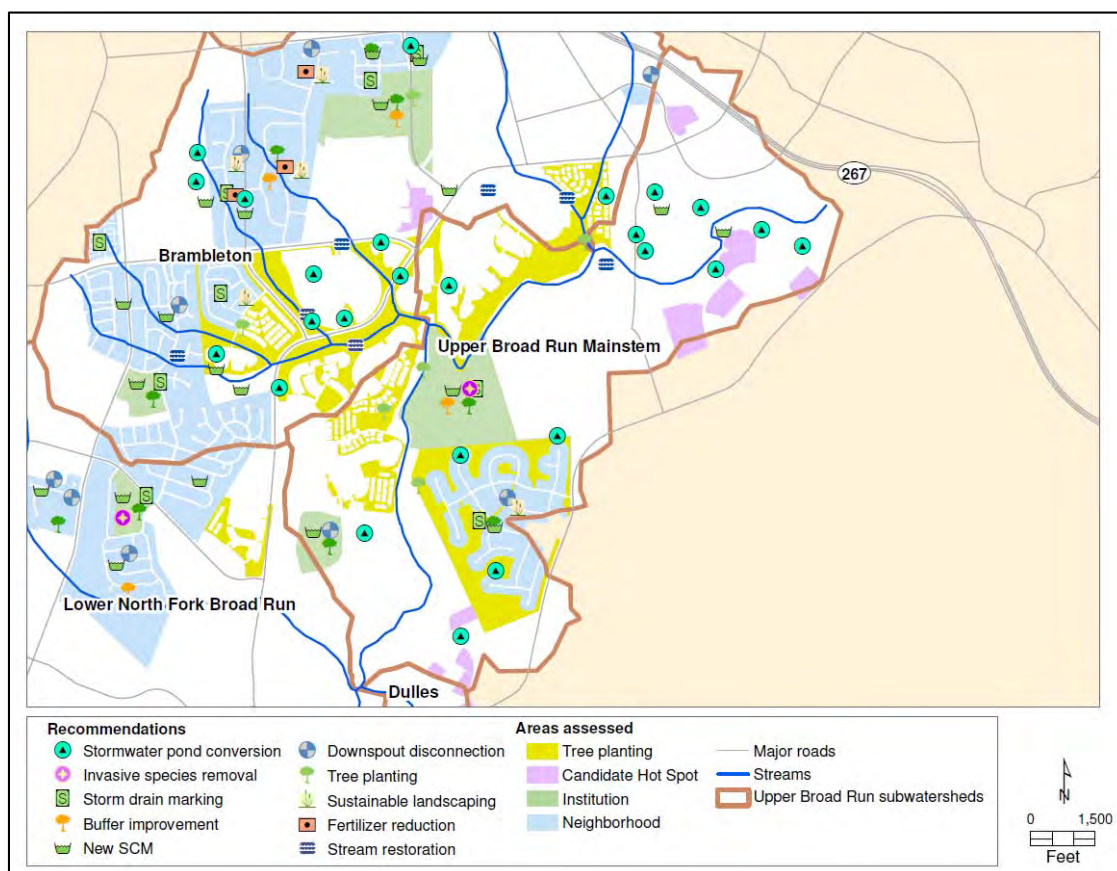
### ***Stormwater Conversions***

A total of 13 existing stormwater management ponds in the Upper Broad Run Mainstem subwatershed were targeted for Retrofit Reconnaissance Investigations. The conversion feasibility,

along with subsequent potential to improve water quality, was ranked for each facility. Of the 13 ponds, 2 were ranked as High, 8 as Medium, 1 as Low/Medium, 1 as Low, and 1 as Very Low.

### ***Subwatershed Management Strategy***

Figure 7-27 provides a visual summary of potential restoration opportunities in the Upper Broad Run Mainstem subwatershed.



**Figure 7-27: Preliminary Restoration Opportunities in Upper Broad Run Mainstem Subwatershed**

### **Engaging Citizens and Watershed Groups**

1. Conduct appropriate downspout rain garden installation measures in the neighborhood according to Table 7-7.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhood indicated in Table 7-7.
3. Educate citizens about the benefits and importance of conservation planting and its effects on water quality for the neighborhood indicated in Table 7-7.
4. Educate property owners about improving stream buffer management at the location indicated in Table 7-7.

5. Encourage the community to plant open space trees. Table 7-7 shows the potential for planting as many as 702 open space trees in the neighborhood that was assessed.
6. Engage institutional sites listed in Table 7-9 in tree planting and new SCMs.
7. Investigate the pervious areas described in Table 7-10 for potential tree planting.

### Municipal Actions

1. Follow-up regarding conditions at confirmed and severe hotspots and continue to monitor conditions at potential hotspots indicated in Table 7-8.
2. Educate staff of the two schools about the importance of proper trash management as listed in Table 7-9.
3. Consider enhancing the forested stream buffer in places where there are no utility conflicts.
4. Consider upgrading the stormwater management ponds described above that were ranked High or Medium for their potential conversion to improve water quality.

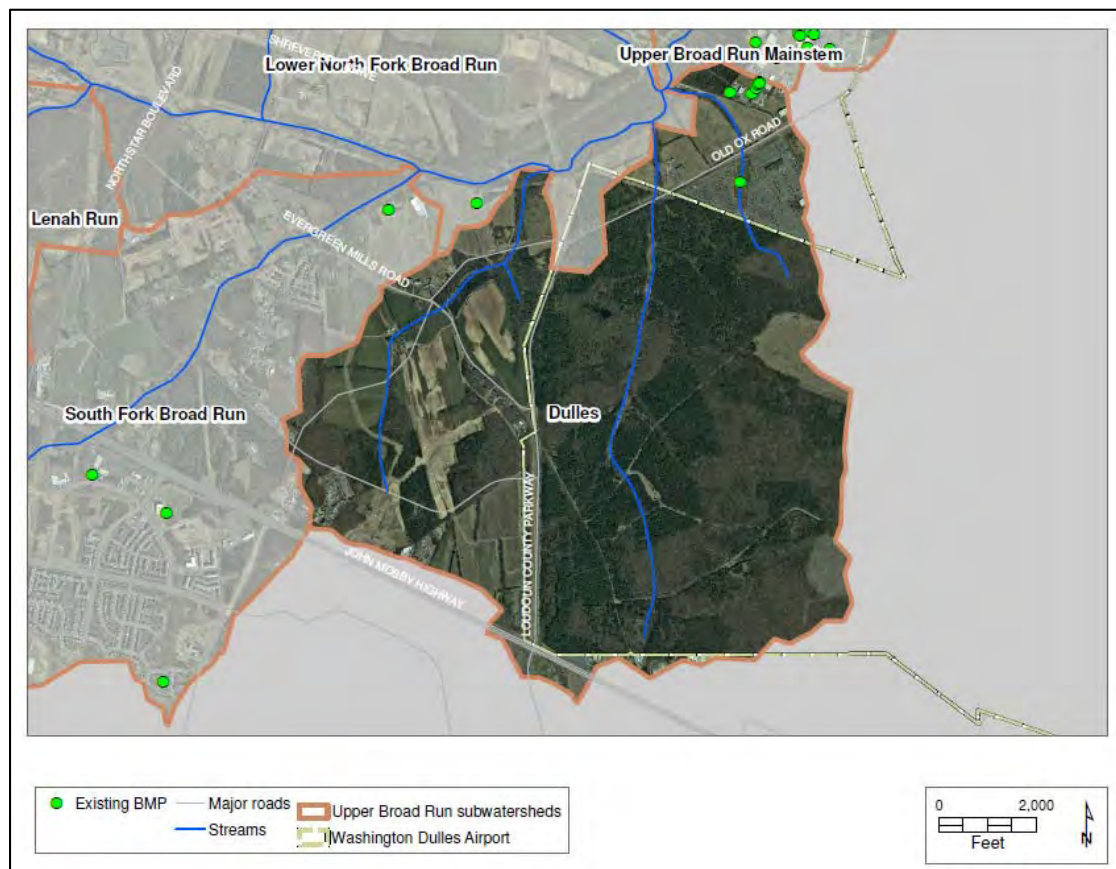
## **7.3 Dulles**

Dulles is the second smallest subwatershed in the Upper Broad Run watershed. The majority of the subwatershed is located on Dulles International Airport property, and therefore only a small portion of the subwatershed could be assessed. Field crews were able to conduct hotspot site investigations on a few business properties in the subwatershed and assess only the flowing streams outside of airport property. Figure 7-28 shows the existing conditions (as of 2012) within the subwatershed. Table 7-11 summarizes the key subwatershed characteristics of Dulles.

**Table 7-11: Key Characteristics – Dulles Subwatershed**

Drainage Area	2,160.5 acres (3.4 sq. mi.)	
Stream Length	4.8 miles	
Land Use/Land Cover	Barren:	0.2%
	Cropland:	10.3%
	Forest:	64.9%
	Pasture:	6.7%
	Urban Impervious:	5.5%
	Urban Pervious:	11.1%
	Water:	0.8%
	Missing:	0.5%
Impervious Cover	136.4 acres (6.3%)	
Soils	A Soils (low runoff potential):	0%
	B Soils:	1.2%
	C Soils:	12.3%
	D Soils (high runoff potential):	26.7%
	No Data:	57.3%
	*B/D Soils:	1.2%
	*C/D Soils:	1.3%
SCMs	5.7% of subwatershed treated	

\*Dual Hydrologic Soil Group. See Chapter 3 for further detail.



**Figure 7-28: Existing Conditions - Dulles Subwatershed**

### *Neighborhoods*

No neighborhood source assessments were performed within the Dulles subwatershed.

### *Hotspots*

Dulles subwatershed of the Upper Broad Run watershed, contains a portion of the Dulles Business Center. Teams investigated two businesses in Dulles Business Center and a separate landscaping business elsewhere in the subwatershed. One business is located within both Dulles and Upper Broad Run Mainstem subwatersheds, but is included in the Dulles narrative section. A summary of field results and preliminary recommendations is presented in Table 7-12.

**Table 7-12: HSI Results and Recommendations – Dulles**

Site ID	Active Pollution Observed			Recommended Follow-up Actions			Hotspot Status			
	Vehicle Operations	Outdoor Materials	Physical Plant	Refer for Enforcement	Follow Up Inspection	Include in Future Education	Not	Potential	Confirmed	Severe
HSI-012								✓		
HSI-014	✓		✓	✓	✓	✓				✓
HSI-015						✓		✓		

Upon arrival at HSI-014, Versar investigators immediately noted an employee power washing equipment in an impervious area behind the building (Figure 7-29). After documenting conditions elsewhere on the business property, field staff returned to the loading dock area to find an employee dumping floor cleaning machine contents into a storm drain inlet. The activity would potentially be considered an illicit discharge; therefore, County staff were promptly notified. In addition, staff identified a number of potential pollution causing practices onsite. The company stores, maintains, and repairs its equipment and vehicles outside. Additionally, an outdoor fueling station is present and was found not to have a canopy cover (Figure 7-30). Vehicle parts and a pile of gravel were found outdoors. Beneficial actions for HSI-014 include instructing employees on the proper disposal of material to avoid illicit discharges. The site can be retrofit so that any equipment washing required takes place indoors and the effluent directed to a sanitary sewer. Inventory, parts, and equipment stored outside, as well as the fueling station, should be sheltered to decrease the likelihood of pollutants washing onto impervious surfaces and being transported to the storm drain system.



**Figure 7-29: Power Washing of Equipment Outside (left) and Dumping of Floor Cleaner Contents into a Storm Drain Inlet (right) at HSI-014**



**Figure 7-30: Uncovered Fueling Station (left) and Uncovered Equipment Storage Yard (right) at HSI-014**

HSI-015 includes three transportation maintenance businesses. On the site, Versar field staff found open, overflowing dumpsters (Figure 7-31). Field staff also noted fleet vehicles likely belonging to one of the companies. To reduce pollution problems, fleet vehicles should be stored under canopy cover and if repair is required, the service should be performed indoors. To reduce the possibility of blowing trash leaving the site and being washed into a storm drain, and to reduce the possibility of dumpster leachate doing the same, employees should be trained in proper waste management techniques.



**Figure 7-31: Loose Trash (left) and Open Dumpster (right) at HSI-015**

Investigators visiting a garden center identified a number of housekeeping issues that could potentially lead to introduction of pollution into storm drains and subsequently to streams. The garden center has a large yard on a pervious (gravel) base. On the pervious portion was situated an array of stalls that had bulk mulch, sand, and other material. Near the entrance of the business, a portion of a mulch stall was placed on hardened asphalt (impervious) near a curb cut leading to a ditch (Figure 7-32). The ditch, located next to U.S. Route 50, had self-converted to a wetland.

Bulk materials such as these that could easily suspend and wash into waterways during heavy downpours would benefit from canopy cover.



**Figure 7-32: Uncovered Inventory Stalls on Pervious Surface (left) and a Portion of Impervious Surface (right) Near an Inlet to a Stormwater Ditch (background right) at HSI-012**

Elsewhere on the property, field teams found large tanks that at one time had contained fuel, according to an employee. At least one other tank appeared to be still in use for fueling purposes, though without a canopy cover. A canopy cover over the fueling station would reduce the possibility of pollutants and hydrocarbons being transported to waters of Dulles subwatershed. The station would also benefit from secondary containment to keep spills localized in the first place. Investigators found and documented collections of discarded material (e.g., pallets), an overflowing rollaway dumpster (Figure 7-33), garden center supplies (e.g., pots), and inventory (e.g., boulders on pallets), all of which were stored outside without canopy cover, though mostly on pervious surfaces. Employee training and placement of material under canopies would help improve the quality of stormwater runoff leaving the site.



**Figure 7-33: Overflowing Rollaway Dumpster (left) and Uncovered Fueling Station (right) at HSI-012**

### ***Institutions***

No institutional site investigations were performed within the Dulles subwatershed.

### ***Pervious Areas***

No pervious area assessments were performed within the Dulles subwatershed.

### ***Stream Corridor Assessments***

Field crews walked 0.75 miles of stream (15.7% of total stream miles) within the Dulles subwatershed to identify potential water quality problems, restoration opportunities, and stream corridor preservation opportunities. This survey focused on first through second order stream reaches. A total of 16 problems were identified throughout the Dulles subwatershed. The predominant issues were erosion (several areas rated as severe were located in the northern-most part of the reach assessed), and inadequate buffer (generally rated overall as moderate, with one very severe point near the northern-most part of the reach). One unusual condition consisted of a site on the stream (located close to its confluence with the mainstem of Broad Run) where black, unusually colored water in the stream possessed an odor of sewage. This site is adjacent to the existing sewer line ROW, and it is possible that a leak had occurred (or continues to occur) here, though it is also possible that the color and odor were due to decaying leaf litter. This site should be investigated as soon as possible, and checked for leaks in the adjacent sewer lines. An appropriate level of cleanup should take place at this location (and other downstream locations, as necessary) after leaks are fixed. Maps showing key findings of the stream corridor assessments are found in Section 4.1.

### ***Stormwater Conversions***

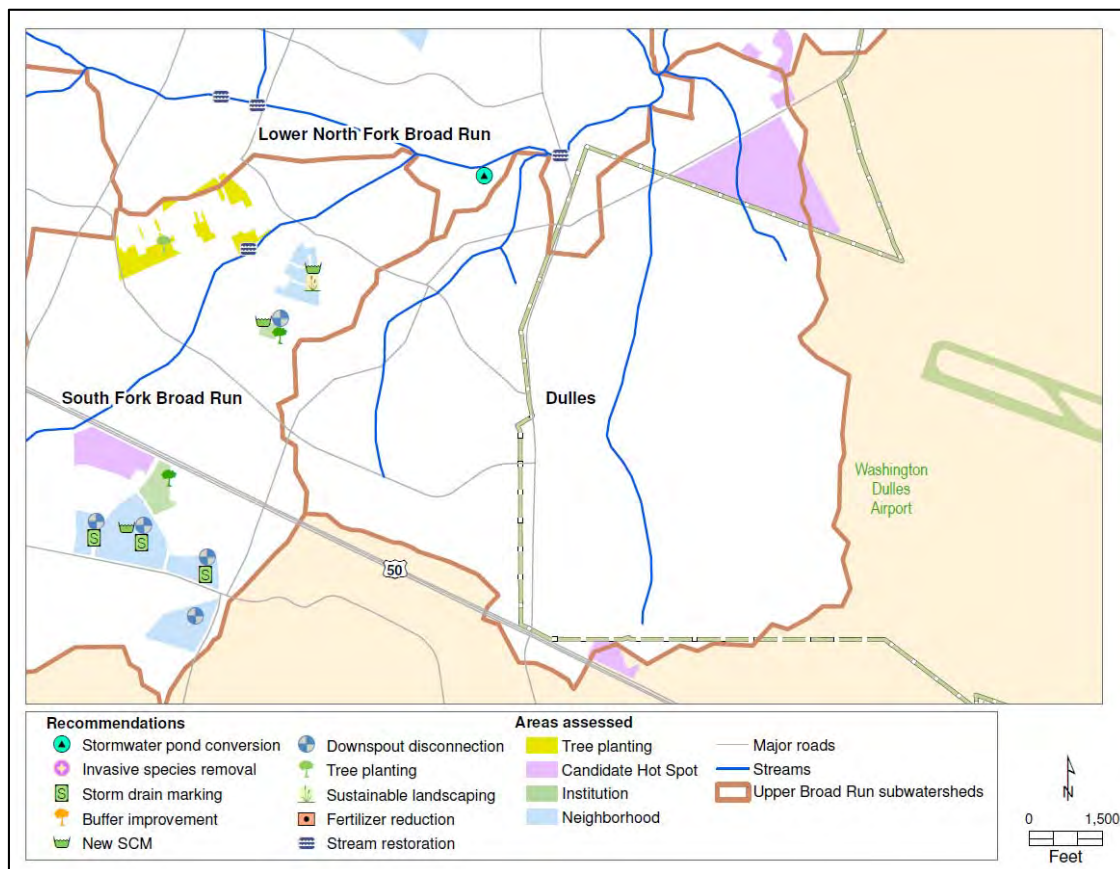
No existing stormwater management ponds were assessed within the Dulles subwatershed.

### ***Subwatershed Management Strategy***

Figure 7-34 provides a visual summary of potential restoration opportunities in the Dulles subwatershed.

### **Municipal Actions**

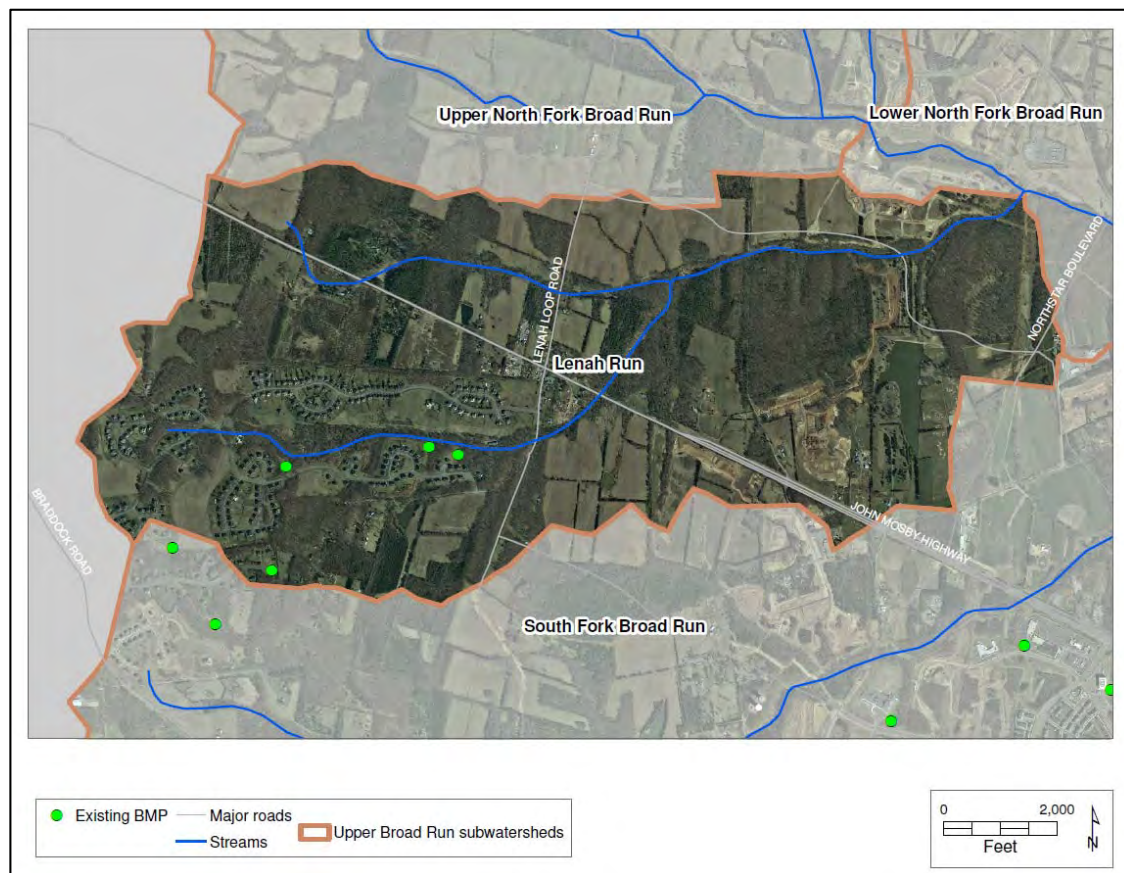
1. Follow-up regarding conditions at severe hotspot, and continue to monitor potential hotspots as indicated in Table 7-12.
2. Investigate cause of black stream water color and odor (possibly due to decaying organic matter) in assessed stream reach.



**Figure 7-34: Preliminary Restoration Opportunities in Dulles Subwatershed**

## 7.4 Lenah Run

Lenah Run is the third smallest subwatershed in the Upper Broad Run watershed. The subwatershed is mainly cropland and forest, with the Lenah Run community (largest neighborhood assessed in the watershed) covering most of the non-agricultural and non-forested portions of the subwatershed. Lenah Run's population density is currently less than one person per acre (see Figure 3-9), but population is expected to grow rapidly within the next few decades. Figure 7-35 shows the existing conditions (as of 2012) within the subwatershed. Table 7-13 summarizes the key subwatershed characteristics of Lenah Run.



**Figure 7-35: Existing Conditions – Lenah Run Subwatershed**

**Table 7-13: Key Characteristics – Lenah Run Subwatershed**

Drainage Area	2,200.5 acres (3.4 sq. mi.)	
Stream Length	4.7 miles	
Land Use/Land Cover	Barren:	0.0%
	Cropland:	20.9%
	Forest:	41.2%
	Pasture:	13.6%
	Urban Impervious:	3.3%
	Urban Pervious:	18.4%
	Water:	1.5%
	Missing:	1.0%
Impervious Cover	91.0 acres (4.1%)	
Soils	A Soils (low runoff potential):	0%
	B Soils:	37.6%
	C Soils:	21.8%
	D Soils (high runoff potential):	20.8%
	*B/D Soils:	4.9%
	*C/D Soils:	13.5%
SCMs	3.3% of subwatershed treated	

\*Dual Hydrologic Soil Group. See Chapter 3 for further detail.

## Neighborhoods

A total of two distinct neighborhoods were identified and assessed within the Lenah Run subwatershed during the uplands assessment of the Upper Broad Run watershed. Preliminary recommendations for neighborhoods in this subwatershed included actions to reduce stormwater volume and pollutants including downspout disconnection, installation of rain gardens, conservation planting, storm drain marking, stream buffer improvements, new SCMs, and tree planting. A summary of preliminary neighborhood recommended actions is presented in Table 7-14.

**Table 7-14: NSA Recommendations – Lenah Run**

PRELIMINARY RECOMMENDED ACTIONS													
Site ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Conservation Planting	Increase Lot Canopy	Pet Waste	Fertilizer Reduction	Buffer Improvement	New SCM	# of Open Space Trees	Notes
NSA-9	1	60		✓	✓	✓	✓		✓	✓	✓	2,104	Great neighborhood restoration candidate. A lot of open space for tree planting and little obvious stormwater treatment. Some debris in roadside ditches.
NSA-19	1/2	60		✓	✓	✓	✓			✓		530	Similar to NSA-9, but lots are smaller and some SCM facilities present.

Both neighborhoods assessed within the Lenah Run subwatershed had opportunities for improvement. Storm drain marking, rain gardens, conservation planting, and stream buffer improvements were recommended in both neighborhoods, while fertilizer reduction and new SCMs were also recommended in NSA-9. NSA-9 has more open space than any other neighborhood assessed within the Upper Broad Run watershed, which is why it has the largest number of recommended tree plantings. This neighborhood also has a new SCM recommended for an area of mowed lawn that currently conveys stormwater runoff from a large portion of the neighborhood to the local stream (Figure 7-36). Installation of a bioretention area, among other SCM options, would allow for a greater removal of pollutants. In addition to treating stormwater on a neighborhood scale, the large percentage of lots covered by mowed lawns in both neighborhoods provides a great opportunity to reduce stormwater runoff at the individual lot scale through rain garden installation and conservation planting.



**Figure 7-36: Grassy Field that Conveys Stormwater Runoff from Impervious Surfaces within NSA-9 to the Local Stream**

### ***Hotspots***

No hotspot site investigations were performed within the Lenah Run subwatershed.

### ***Institutions***

No institutional site investigations were performed within the Lenah Run subwatershed.

### ***Pervious Areas***

No pervious area assessments were performed within the Lenah Run subwatershed.

### ***Stream Corridor Assessments***

Field crews walked 1.99 miles of stream (42.3% of total stream miles) within the Lenah Run subwatershed to identify potential water quality problems, restoration opportunities, and stream corridor preservation opportunities. This survey focused on first through second order stream reaches. A total of 37 problems were identified throughout the Lenah Run subwatershed. The predominant issues were erosion (worst in the northeastern reach) and inadequate buffer (worst in the northeastern reach where it was rated very severe; also bad in the western reach, where it was rated severe). Two pipe outfalls were also noted, both consisting of small diameter plastic drain pipe; both exhibited evidence of stormwater discharge (both were rated as minor). One unusual condition, consisting of a likely former dam site (judging by the presence of non-native rock materials on the streambank and stratified bank sediments), was noted in the central reaches of the subwatershed. This site did not appear to be posing any obvious issues, and was rated as

minor. All areas of the northeastern and western reaches that possess very severe and severe stream buffers should be planted with native shrubs and trees wherever possible to improve stream conditions, and for wildlife. Maps showing key findings of the stream corridor assessments are found in Section 4.1.

### ***Stormwater Conversions***

A total of 2 existing stormwater management ponds in the Lenah Run subwatershed were targeted for Retrofit Reconnaissance Investigations. The conversion feasibility, along with subsequent potential to improve water quality, was ranked for each facility. Of the 2 ponds, 1 was ranked as Medium/High, and 1 as Medium.

### ***Subwatershed Management Strategy***

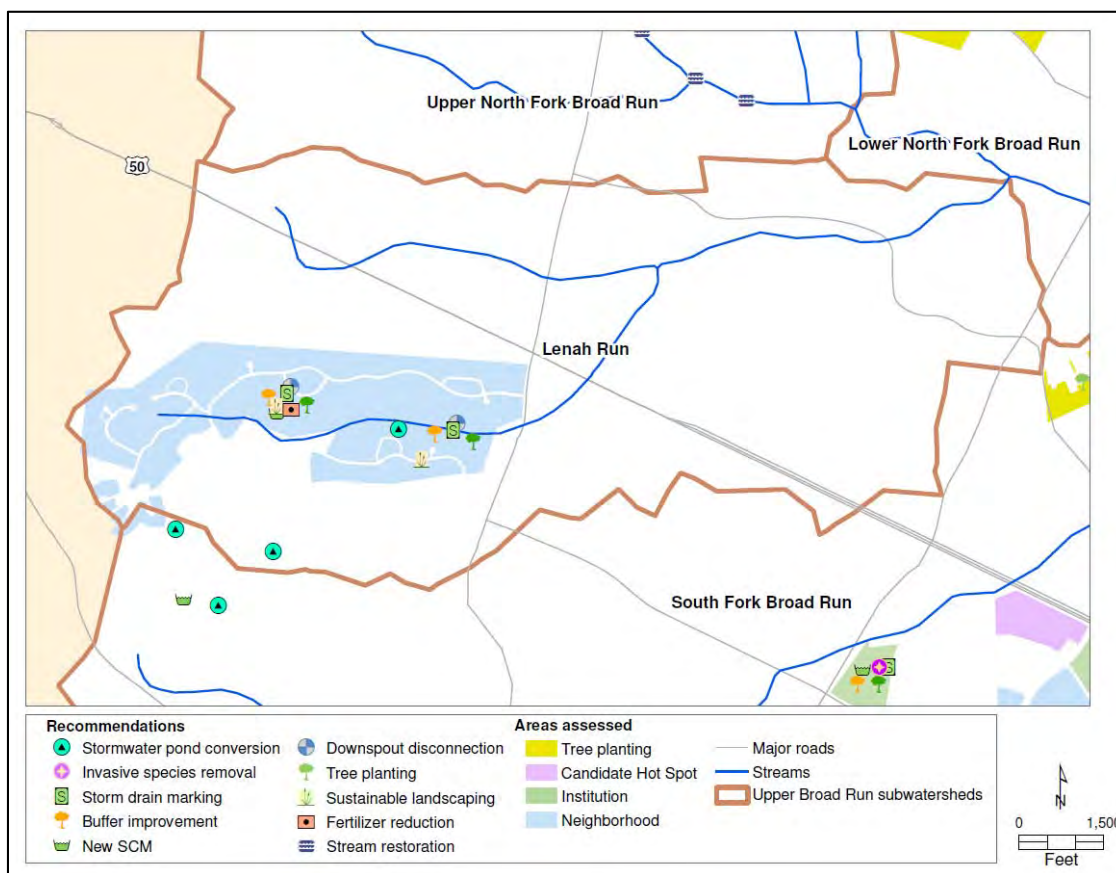
Figure 7-37 provides a visual summary of potential restoration opportunities in the Lenah Run subwatershed.

### **Engaging Citizens and Watershed Groups**

1. Conduct appropriate downspout rain garden installation measures in neighborhoods according to Table 7-14.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 7-14.
3. Educate citizens about the benefits and importance of conservation planting and its effects on water quality for neighborhoods indicated in Table 7-14.
4. Educate property owners about the water quality benefits of reducing fertilizer use on lawns as indicated in Table 7-14.
5. Educate property owners about improving stream buffer management at locations indicated in Table 7-14.
6. Encourage communities to plant open space trees. Table 7-14 shows potential neighborhoods for planting as many as 2,634 open space trees.

### **Municipal Actions**

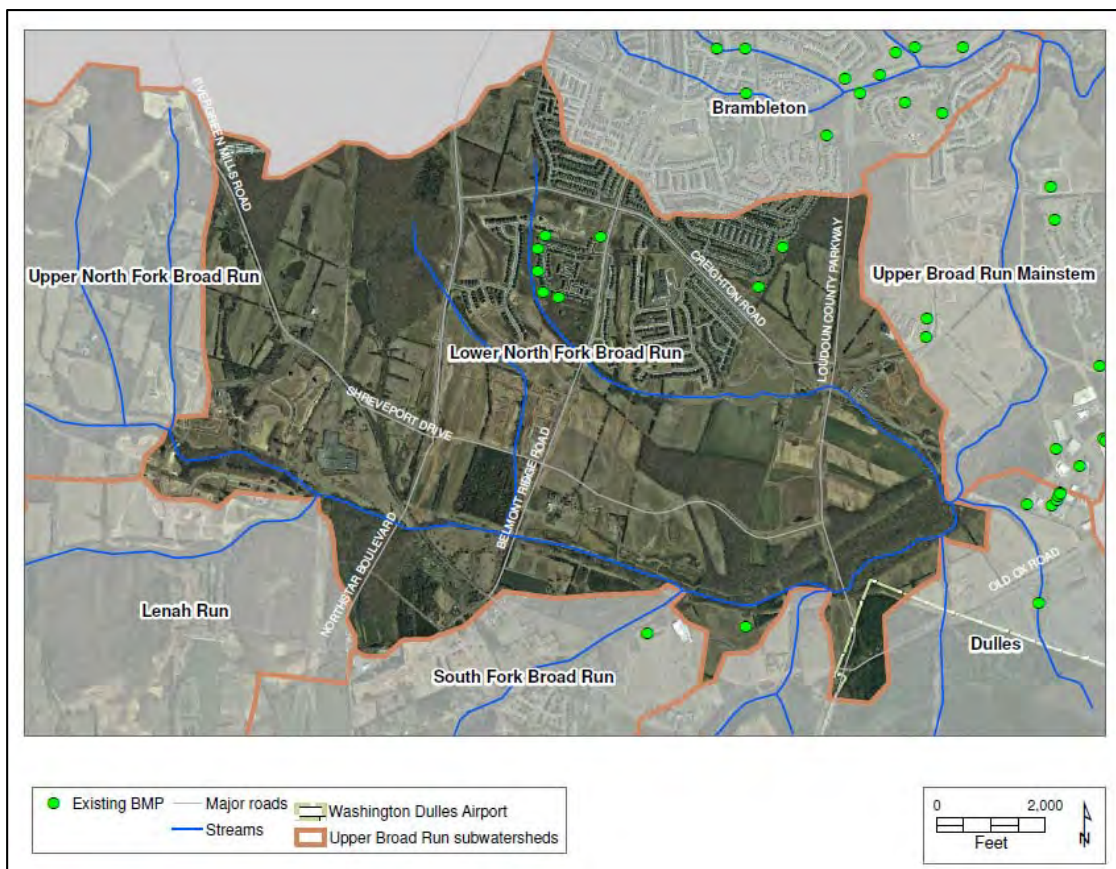
1. Consider enhancing the forested stream buffer in places where there are no utility conflicts.
2. Work with the residents of NSA-9 to pursue the large SCM opportunity noted in Table 7-14.
3. Consider upgrading the stormwater management ponds described above to improve water quality.



**Figure 7-37: Preliminary Restoration Opportunities in Lenah Run Subwatershed**

## 7.5 Lower North Fork Broad Run

Lower North Fork Broad Run is the second largest subwatershed in the Upper Broad Run watershed. The subwatershed is mainly cropland and forest, though the northeastern corner is heavily residential due to the presence of several Brambleton Landbay communities. The largest number of stream miles was assessed within this watershed due to its benthic and bacteria impairments. Figure 7-38 shows the existing conditions (as of 2012) within the subwatershed. Table 7-15 summarizes the key subwatershed characteristics of Lower North Fork Broad Run.



**Figure 7-38: Existing Conditions – Lower North Fork Broad Run Subwatershed**

**Table 7-15: Key Characteristics – Lower North Fork Broad Run Subwatershed**

Drainage Area	2,472.6 acres (3.9 sq. mi.)	
Stream Length	6.8 miles	
Land Use/Land Cover	Barren:	0.2%
	Cropland:	27.0%
	Forest:	27.4%
	Pasture:	16.5%
	Urban Impervious:	6.2%
	Urban Pervious:	20.1%
	Water:	2.0%
	Missing:	0.7%
Impervious Cover	185.6 acres (7.5%)	
Soils	A Soils (low runoff potential):	0%
	B Soils:	0.7%
	C Soils:	39.3%
	D Soils (high runoff potential):	44.1%
	*B/D Soils:	9.5%
	*C/D Soils:	3.6%
SCMs	3.8% of subwatershed treated	

\*Dual Hydrologic Soil Group. See Chapter 3 for further detail.

## Neighborhoods

A total of four distinct neighborhoods were identified and assessed within the Lower North Fork Broad Run subwatershed during the uplands assessment of the Upper Broad Run watershed. Preliminary recommendations for neighborhoods in this subwatershed included actions to reduce stormwater volume and pollutants including downspout disconnection, stream buffer improvements, new SCMs, and tree planting. A summary of preliminary neighborhood recommended actions is presented in Table 7-16.

**Table 7-16: NSA Recommendations – Lower North Fork Broad Run**

PRELIMINARY RECOMMENDED ACTIONS													
Site ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Conservation Planting	Increase Lot Canopy	Pet Waste	Fertilizer Reduction	Buffer Improvement	New SCM	# of Open Space Trees	Notes
NSA-2A	N/A	65										167	Tree planting opportunity in large open field between basketball court and gazebo.
NSA-2B	1/4	30									✓		
NSA-4B	< 1/4	20									✓		
NSA-5	< 1/4	45								✓	✓		

All of the neighborhoods assessed within the Lower North Fork Broad Run subwatershed had at least one opportunity for improvement. Three neighborhoods had greater than 25% of their downspouts draining directly or indirectly to the storm drain. The average lot in these neighborhoods had enough space to redirect the downspout runoff to pervious surfaces (Figure 7-39), but individual rain garden installations were not recommended due to site constraints. NSA-2B, NSA-4B, and NSA-5 all had opportunities for new SCMs in common areas (Figure 7-40). NSA-2A was not recommended for the addition of SCMs, but had a tree planting opportunity in an upland area that is currently mowed lawn.

## Hotspots

One site was investigated within the Lower North Fork Broad Run subwatershed of Upper Broad Run: a landscaping and nursery business whose property is now owned by a developer. The property manager informed Versar field staff that they (the former owners) are leasing back the property from the developer and that they expect to be requested to vacate so that development of the parcel may proceed. A summary of field findings and preliminary recommendations at this site is presented in Table 7-17.



**Figure 7-39: Typical Downspouts and Front Yards in NSA-5 with an Opportunity to Redirect Downspouts to Pervious Area**



**Figure 7-40: Rain Garden Installation Opportunity in NSA-5 (left) and NSA-4B (right)**

**Table 7-17: HSI Results and Recommendations –  
Lower North Fork Broad Run**

Site ID	Active Pollution Observed			Recommended Follow-up Actions			Hotspot Status			
	Vehicle Operations	Outdoor Materials	Physical Plant	Refer for Enforcement	Follow Up Inspection	Include in Future Education	Not	Potential	Confirmed	Severe
HSI-013								✓		
Note: No active pollution observed or follow-up actions recommended for this subwatershed.										

Staff assessed the site anyway and noted the following potential pollution causing activities: storage of soil, mulch, and building materials in the open without a cover; greenhouse infrastructure open to the elements; storage of building materials in the open; an open dumpster; and other bulk material, tools, equipment, and discarded items stored in the open in piles or scattered on the property (Figure 7-41). All of the items above were stored on pervious surfaces such as grass, dirt, or gravel. An ephemeral channel was also noted on the parcel in the midst of an open yard area. Material stored outside should be appropriately sheltered to shield potential pollution causing material from the washing effects of precipitation. Additionally, the tributary of Lower North Fork Broad Run which forms on the property should be buffered to prevent erosion and help filter out harmful pollutants in developed areas.



**Figure 7-41: Greenhouse with Missing Roof (left) and Pile of Building Materials (right) at HSI-013.**

### *Institutions*

In the Lower North Fork Broad Run subwatershed, just one institution was investigated by field staff. A summary of potential opportunities for restoration at Creighton's Corner Elementary School are presented in Table 7-18.

**Table 7-18: ISI Recommendations – Lower North Fork Broad Run**

PRELIMINARY RECOMMENDED ACTIONS									
Site ID	Name	Storm Drain Marking	# Trees for Planting	Downspout Disconnection	New SCM	Impervious Cover Removal	Buffer Improvement	Trash Management	Notes
ISI-008	Creighton's Corner Elementary School	✓	510		✓			✓	

Restoration and opportunities to communicate and learn about them are plentiful at Creighton's Corner Elementary School. Field staff noted substantial grassy square footage that could be converted to more stormwater-friendly tree stands. Field staff noted areas on the southeast periphery, in the center of the bus turnaround drive, and adjacent to and between athletic fields. Further, an area at the north corner of the property has not been cleared for construction and which should be preserved and augmented with additional trees. These tree planting measures, if taken, would increase the forest canopy coverage at the school from 25% to nearly 50%. Tree planting would promote stormwater infiltration as well as reduce maintenance costs involved with mowing and maintaining turf areas around the school. Where trees would not be appropriate, conservation planting could be used instead. Adding to stormwater management opportunities around the school are areas where sheetflow from grassy and athletic areas are causing erosion problems. The southwest corner of the baseball diamond is such an example. Installation of bioretention in conjunction with terraces along the impacted hillside would reduce transport of sediment to the nearby storm drain inlet (Figure 7-42). Like many schools, the staff could benefit from waste management training so that pollutants are not transported from dumpsters to storm drain inlets.



**Figure 7-42: Tree Planting Opportunity in Bus Turnaround Area (left) and Bioretention Opportunity (right) at Creighton's Corner Elementary School**

### *Pervious Areas*

Pervious area restoration has the potential to convert areas of turf and other maintained cover, which often have high nutrient inputs to forest, which can instead absorb and filter nutrients. One pervious area was assessed for restoration potential in Lower North Fork Broad Run; this site is Hanson Regional Park. The **Hanson Regional Park** site is located on two separate parcels to the east and west of Evergreen Mills Road, near its intersection with Founders Drive. As of January 2014, the Park is still in its planning stages, and no facilities exist at the site yet. It will be publicly-owned and maintained, however, and is easily accessible by foot, vehicle, or heavy equipment. Owing to the fact that the site is part of a historic area farm, nearly the entire site was either grazed or cropped. Consequently, no turf cover (0%) currently exists at the site. The Park site includes primarily large fallow fields, with various small woodlots and fencerows,

particularly along several unnamed intermittent and perennial tributaries. The streams were historically dammed into a series of four small ponds and one medium-sized pond. The 2013 Hanson Regional Park Master Plan was reviewed for planned uses of the Park. Several areas of the Park without specific planned future uses were recommended for reforestation with minimal site preparation to buffer the existing streams, ponds, and nontidal wetland buffers throughout both major Park parcels. Forest re-establishment in these locations would help to buffer the existing streams and wetlands, and would enhance the aesthetic beauty of the Park.

A summary of this site is provided in the Table 7-19.

**Table 7-19: PAA Summaries – Lower North Fork Broad Run**

Site ID	Location in Sub-watershed	Description	Acres	Ownership
Hanson Regional Park	Northwest	County Park	Parcel – 256.18 Recommended planting – 25.19	Public

### ***Stream Corridor Assessments***

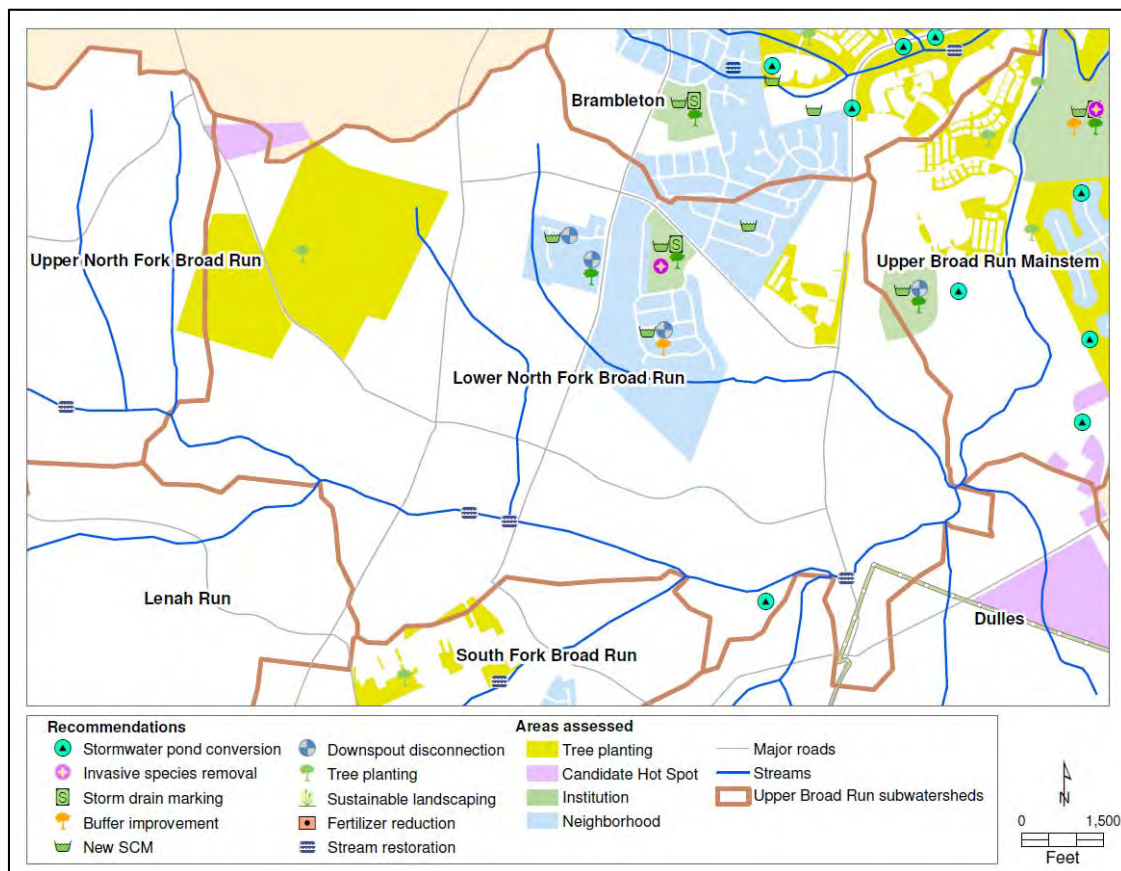
Field crews walked 2.73 miles of stream (40.4% of total stream miles) within the Lower North Fork Broad Run subwatershed to identify potential water quality problems, restoration opportunities, and stream corridor preservation opportunities. This survey focused on a third order stream reach. A total of 52 problems were identified throughout the Lower North Fork Broad Run subwatershed. The predominant issues were erosion (worst in the western-most reaches) and inadequate buffer (worst in the central reaches) throughout. Also noted were several unusual conditions, two of them log jams relating to beaver activity, and causing elevated water levels. Another condition, consisting of a large exposed area of bedrock and nearly vertical faces of shale (roughly 500 feet in length) along the stream in the east-central part of the subwatershed, was noted because it is a unique geologic feature. Maps showing key findings of the stream corridor assessments are found in Section 4.1.

### ***Stormwater Conversions***

One existing stormwater management pond in the Lower North Fork Broad Run subwatershed was targeted for Retrofit Reconnaissance Investigations. The conversion feasibility, along with subsequent potential to improve water quality, was ranked as Very Low for this facility.

### ***Subwatershed Management Strategy***

Figure 7-43 provides a visual summary of potential restoration opportunities in the Lower North Fork subwatershed.



**Figure 7-43: Preliminary Restoration Opportunities in Lower North Fork Broad Run Subwatershed**

#### Engaging Citizens and Watershed Groups

1. Conduct appropriate downspout disconnections in neighborhoods with greater than 25% opportunity for disconnection as shown in Table 7-16.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhood indicated in Table 7-16.
3. Educate property owners about improving stream buffer management at locations indicated in Table 7-16.
4. Encourage communities to plant open space trees. Table 7-16 shows a potential neighborhood for planting as many as 167 open space trees.
5. Engage institutional sites listed in Table 7-18 in tree planting and new SCMs.
6. Investigate the pervious areas described in Table 7-19 for potential tree planting.

## Municipal Actions

1. Continue to monitor conditions at the potential hotspot indicated in Table 7-17.
2. Work with the institution owners to pursue SCM opportunities at public institutions noted in Table 7-18.
3. Consider preliminary recommendations for stream restoration in areas of moderate to severe bank erosion and channel alteration, as noted during the SCA.
4. Consider enhancing the forested stream buffer in places where there are no utility conflicts.
5. Evaluate land preservation options for areas adjacent to high quality streams, as identified in the stream corridor assessment.

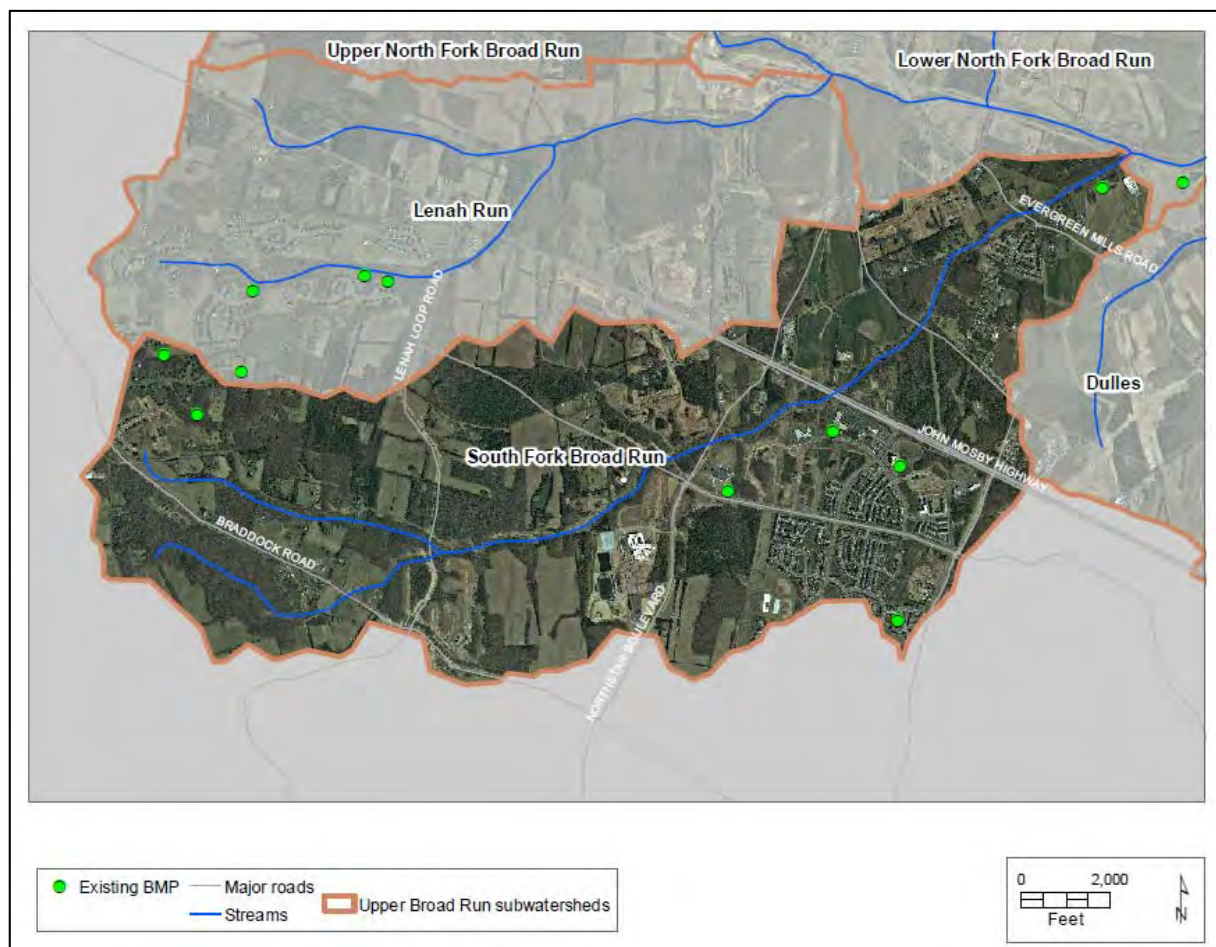
## **7.6 South Fork Broad Run**

South Fork Broad Run is the largest subwatershed in the Upper Broad Run watershed. The subwatershed is mainly residential in the south-central portion and forested in the western and eastern portions, though residential land use is shifting towards the west as several new residential developments are currently being constructed there. High quality forests and wetlands are also located in the western portion of the subwatershed and are described in the stream corridor discussion. Figure 7-44 shows the existing conditions (as of 2012) within the subwatershed. Table 7-20 summarizes the key subwatershed characteristics of South Fork Broad Run.

**Table 7-20: Key Characteristics – South Fork Broad Run Subwatershed**

Drainage Area	3,594.7 acres (5.6 sq. mi.)	
Stream Length	6.4 miles	
Land Use/Land Cover	Barren:	0.2%
	Cropland:	16.0%
	Forest:	41.1%
	Pasture:	13.6%
	Urban Impervious:	6.4%
	Urban Pervious:	20.4%
	Water:	1.2%
	Missing:	1.2%
Impervious Cover	273.6 acres (7.6%)	
Soils	A Soils (low runoff potential):	0%
	B Soils:	13.8%
	C Soils:	18.7%
	D Soils (high runoff potential):	54.6%
	*B/D Soils:	5.0%
	*C/D Soils:	7.4%
SCMs	6.2% of subwatershed treated	

\*Dual Hydrologic Soil Group. See Chapter 3 for further detail.



**Figure 7-44: Existing Conditions – South Fork Broad Run Subwatershed**

### *Neighborhoods*

A total of five distinct neighborhoods were identified and assessed within the South Fork Broad Run subwatershed during the uplands assessment of the Upper Broad Run watershed. Preliminary recommendations for neighborhoods in this subwatershed included actions to reduce stormwater volume and pollutants including downspout disconnection, use of rain barrels, conservation planting, storm drain marking, stream buffer improvements, and SCMs. A summary of preliminary neighborhood recommended actions is presented in Table 7-21.

All neighborhoods assessed within the South Fork Broad Run subwatershed had opportunities for improvement. Storm drain marking, rain barrels, stream buffer improvements, and SCMs were each recommended for several neighborhoods. Four of the neighborhoods assessed were either condominiums or attached townhomes with little green space, which is why downspouts are recommended for redirection to rain barrels. These rain barrels can serve as temporary storage of roof runoff, decreasing the volume of stormwater running off site, but can also do a great job of promoting stormwater runoff awareness. Stream buffer improvement was recommended for two neighborhoods, one of which, NSA-20, has a parking lot located within 15 feet

of a stream (Figure 7-45). NSA-18 and NSA-22 were both recommended for new SCMs (Figure 7-46).

**Table 7-21: NSA Recommendations – South Fork Broad Run**

PRELIMINARY RECOMMENDED ACTIONS													
Site ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Conservation Planting	Increase Lot Canopy	Pet Waste	Trash Management	Buffer Improvement	New SCM	# of Open Space Trees	Notes
NSA-0	N/A	100	✓		✓		✓			✓			Nearly all downspouts draining the back half of condo rooftops drain directly to impervious. Downspouts in front drain to small grass strips that are less than 15 feet long, and likely do not allow for much infiltration.
NSA-12	N/A	45	✓				✓						
NSA-18	N/A	70	✓		✓		✓				✓		
NSA-20	N/A	90	✓		✓		✓			✓			Parking lot within 15 feet of stream channel.
NSA-22	1/4	5				✓	✓				✓		Good opportunity for rain gardens behind houses.



**Figure 7-45: Stream Buffer Encroachment in NSA-20**



**Figure 7-46: Opportunity for Rain Garden Installation within NSA-22 (left) and NSA-18 (right)**

### *Hotspots*

Versar field staff investigated one site in South Fork Broad Run subwatershed of Upper Broad Run, consisting of a shopping center. The retail area consists of three strip shopping center buildings plus standalone businesses, including one gasoline fueling business. Due to the multiplicity of businesses and possible hotspots, the investigation was broken down into two sub-investigations: western buildings (encompassing a supermarket and shops located in two largest buildings) and eastern buildings (remaining smaller buildings aggregated). Field results and preliminary recommendations are summarized in Table 7-22.

**Table 7-22: HSI Results and Recommendations –  
South Fork Broad Run**

Site ID	Active Pollution Observed			Recommended Follow-up Actions			Hotspot Status			
	Vehicle Operations	Outdoor Materials	Physical Plant	Refer for Enforcement	Follow Up Inspection	Include in Future Education	Not	Potential	Confirmed	Severe
HSI-010							✓			
HSI-011		✓		✓	✓				✓	

Dumpsters located in the loading dock area of a supermarket were found to be covered, but close to a storm drain inlet (Figure 7-47). Dumpsters such as these would benefit from implementation of secondary containment. In the loading dock ramp area, field staff noted several pieces of bulk trash, which are a potential pollution source. Along a walkway to the rear of one of the businesses were several waste cooking oil containers, which could be placed in secondary containment.



**Figure 7-47: Dumpsters Placed Near Storm Drain Inlet (left) and Bulk Trash Items Stored Outside (right) at HSI-010**

Behind the adjacent strip of businesses, a fenced in loading dock area behind a restaurant was found to be filled with surplus items and bulk trash, including a torch, keg storage rack, and pieces of furniture (Figure 7-48). Storage areas such as these could benefit from canopy cover or a permanent structure to redirect rain away from potential pollution sources.



**Figure 7-48: Bulk Items Stored Behind HSI-010**

The eastern portion of the shopping center included free-standing convenience stores, a fueling station, bank, a restaurant, and other businesses arranged in one strip building. These were investigated together and comprise site HSI-011. Versar investigators found instances of bulk material storage in dumpster stalls, overflowing trash cans, and a leaking trash compactor. At a convenience store, staff noted a small pile of deicing salt stored in the open near the store entrance (Figure 7-49). At the same store, crates, bins and other material were found in the open within a dumpster stall. Waste management improvement and remedying of misplaced deicing chemical could be gained by training of employees.



**Figure 7-49: Salt Pile (left) and Leaking Trash Compactor (right) at HSI-011**

Two compactors were found attached to a pharmacy, at least one of which had leaked greasy material onto the impervious surface. The area of the compactors was near a storm drain inlet. At Bank of America, a dumpster was found in good condition, however it was situated next to a curb cut leading to a stormwater facility. Secondary containment to contain potential spills would be beneficial in both of these situations.

### ***Institutions***

In the South Fork Broad Run subwatershed, field staff investigated two public schools and two public institutions (Arcola-Pleasant Valley Fire Station and the Gum Spring Library). A summary of potential opportunities for restoration are presented in Table 7-23.

**Table 7-23: ISI Recommendations – South Fork Broad Run**

PRELIMINARY RECOMMENDED ACTIONS									
Site ID	Name	Storm Drain Marking	# Trees for Planting	Downspout Disconnection	New SCM	Impervious Cover Removal	Buffer Improvement	Trash Management	Notes
ISI-001	Gum Spring Library		23					✓	Minor pretreatment opportunities.
ISI-002	Arcola-Pleasant Valley Fire-Rescue Station 9		8	✓	✓			✓	No storm water infrastructure other than ditch/swale.
ISI-006	John Champe High School		1,746		✓		✓		
ISI-007	Arcola ES	✓	636		✓		✓	✓	

The Gum Spring Library is a recently constructed institution featuring a large stormwater treatment pond that serves the surrounding commercial and residential areas and treats runoff from the library's parking area. The available land is highly utilized, providing limited restoration opportunities. Nevertheless, a public library provides an excellent showcase for communicating the need for Upper Broad Run watershed restoration to patrons. Measures that are already visible on the property include the provision of pet waste bags along the walking path adjacent to the wet pond, pre-stenciled manhole covers, and placement of a recycling dumpster. The planting of additional trees on the berm along the north corner of the property would be an excellent, specific action to promote stormwater infiltration and increase the size of the tree canopy on the property (Figure 7-50). Improvements to waste management include upsizing the recycling container, which was found by field staff to be overflowing with cardboard.



**Figure 7-50: Tree Planting (left) and Waste Management Improvement (right) Opportunities at ISI-001.**

In contrast to the library, the Arcola-Pleasant Valley Fire Station is an older institution with stormwater management challenges characteristic of older facilities. The site features older impervious surface (a portion of the parking lot is breaking up) and in topography it slopes gradually toward Gum Spring Rd. General measures to improve stormwater infiltration on the site include the addition of bioretention in front of and to the side of the maintenance building and in a zone adjacent to Gum Spring Road. At present, the only stormwater treatment offered on the site is a grassy swale along Gum Spring Road (Figure 7-51). Bioretention would increase infiltration of stormwater runoff and reduce the net impervious footprint of the fire station. A further measure to increase stormwater infiltration would be the installation of rain barrels on downspouts. The risk of polluted stormwater would be lessened by implementation of waste management training. Field staff noted the presence of a rusted and overflowing dumpster and a collection of discarded equipment stored on impervious surfaces on the property. Lastly, extending the forested portion of the property to a grassy area behind the main building would further improve onsite stormwater infiltration and provide additional shade to the building.



**Figure 7-51: Rusted and Overflowing Dumpster (left) and Bioretention Opportunity (right) at Arcola-Pleasant Valley Fire Station.**

John Champe High School is an extensive facility that provides ample opportunities for watershed restoration. Field staff noted that the main student parking lot is already provided with modern stormwater treatment in the form of a sand filter and bioretention. The stormwater facility, however, is in need of maintenance due to washout of gravel on the east edge of the lot by runoff originating from a culvert under Lobo Drive. Pervious asphalt is also provided on the northwest faculty parking lot. Potential restoration measures that can improve upon onsite stormwater management include installation of bioretention at a yard drain off the northwest corner of the student lot. A curb cut would divert stormwater runoff in the parking lot to the treatment area. Additionally, a grassy swale running east-to-west along the former Goshen Road (removed) can be converted to linear bioretention to both (a) treat and infiltrate stormwater runoff and (b) mitigate an erosion issue developing on the western edge of the property. Tree cover could be increased on the school campus by utilizing current mowed grass areas along the northern and southern peripheries (Figure 7-52). The trees would partially shade the athletic field complex, improve infiltration of stormwater that currently sheets off compacted, grassed areas, and provide habitat for animal populations. Construction of a sanitary sewer right-of-way off the southwestern edge of the property has encroached on a first order stream buffer as well as the South Fork of Broad Run. Replanting the buffer on both sides of the stream (but outside of the sanitary sewer easement) as well as along tributaries near the southern and northern borders of the high school property would improve water quality by promoting stormwater infiltration, providing bank stability, and improving instream habitat by increasing shading.

Arcola Elementary School is another recently constructed school that provides many candidate restoration opportunities that can improve water quality in the tributary and stream that run along the north and east edges of the property. The availability of grassed areas presents an excellent opportunity to improve the stream buffer and augment existing tree stands near these waterways. Additionally, a large area between faculty parking and Tall Cedars Parkway presents an opportunity to demonstrate improved stormwater infiltration and interception via tree planting. Improvements to stormwater management can also be incorporated into environmental education by encouraging students to select and plant native species in a bioretention area to improve

stormwater infiltration along a grassy swale. Such a new treatment area would absorb and treat runoff from the adjacent drive leading toward the rear recreation area. Training of staff would also be useful to better management of waste. Field staff noted stains leading from the dumpster area toward a storm drain inlet (Figure 7-53). Stains indicate a problem with waste material leaching out of the dumpster and being transported into the storm sewer network.



**Figure 7-52: Tree Planting (left) and Bioretention Opportunity (right) at John Champe High School.**



**Figure 7-53: Tree Planting Opportunity (left) and Impervious Area Staining Near Dumpster Stalls (right) at Arcola Elementary School**

### *Pervious Areas*

Pervious area restoration has the potential to convert areas of turf and other maintained cover, which often have high nutrient inputs to forest, which can absorb and filter rather than contribute nutrients. The **Briarfield Estates HOA** site is located off of Cameron Parish Drive, near Evergreen Mills Road. It is privately-owned, and has one medium-sized potential tree planting area adjacent to a small existing stormwater facility. A large amount of the site currently

possesses turf (60%). Benefits of tree planting here would include the slowing of surface flow runoff to the adjacent stream corridor (southeast of the planting site), and aesthetic improvements to adjacent homeowners.

A summary of this site is provided in the Table 7-24 below.

**Table 7-24: PAA Summaries – South Fork Broad Run**

Site ID	Location in Sub-watershed	Description	Acres	Ownership
Briarfield Estates HOA	Northeast	Private Open Space	Parcel – N/A Recommended planting – 1.97	Private

### ***Stream Corridor Assessments***

Field crews walked 2.57 miles of stream (40.2% of total stream miles) within the South Fork Broad Run subwatershed to identify potential water quality problems, restoration opportunities, and stream corridor preservation opportunities. This survey focused on first through second order stream reaches. A total of 41 problems were identified throughout the South Fork Broad Run subwatershed. The predominant issues were erosion (worst areas in the northern-most part of the eastern reach, where it was rated as severe in places) and insufficient buffer (worst areas in the northern-most part of the eastern reach where it was rated as severe in places, and in the northern part of the western reach, where it was rated severe in places). One unusual condition consisted of a very large pile of discarded sod rolls within about 25 feet of the stream at an adjacent sod farm. This pile has apparently contributed to excess sedimentation in a small area of the adjacent streambed. It is advisable that this sod pile be moved to an upland location at least 300 feet from the stream. Additionally, two separate large, dense stands of non-native, invasive bamboo were noted along the banks of the stream downstream of the sod farm. Some of the bamboo on the outer edges of the streambank was falling into the stream and pulling away the streambank, exacerbating further erosion. These bamboo stands should be eliminated as soon as possible before they spread even further; native trees and shrubs should be planted in place of the bamboo. Maps showing key findings of the stream corridor assessments are found in Section 4.1.

South Fork Broad Run's headwater area was recommended for stream corridor preservation (Figure 7-54). This headwater stream was broken into many small, braided channels connected directly to, or only inches above, the floodplain. Little flow was present here, and almost no bank erosion existed. Most of the upper area possessed broad, forested nontidal wetland buffers; though some recent land clearing activity was encroaching on these buffers in certain areas. The forested buffers possessed moderately large, second-growth deciduous trees, consisting of mainly of pin and white oaks, red maple, and boxelder. Spicebush, cinnamon fern, and Virginia chain fern were the principal species in the shrub and herbaceous layers.

It is important that headwater areas such as these in the Upper Broad Run watershed be preserved wherever possible. Scientific evidence clearly shows that healthy headwaters are inextricably linked to the health of downstream and river ecosystems. Well-buffered, undisturbed headwaters supply organic matter that contributes to the growth and productivity of higher

organisms, including insects and fish. Headwaters also help to keep sediment and pollutants out of the stream system's lower reaches. In addition, they enhance biodiversity by supporting flora and fauna that are uniquely acclimated to this habitat.



**Figure 7-54: Downstream Section (left) and Upstream Section (right) of Stream Corridor Recommended for Preservation within South Fork Broad Run**

### *Stormwater Conversions*

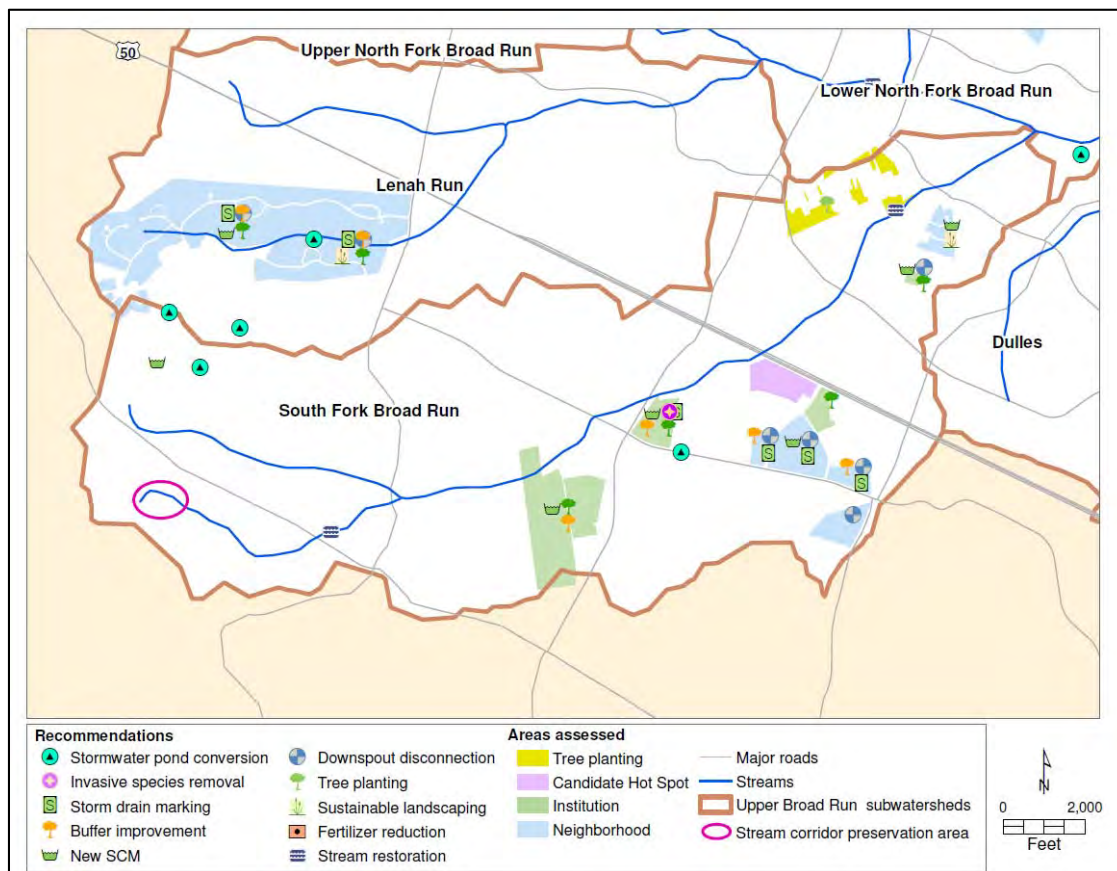
A total of 3 existing stormwater management ponds in the South Fork Broad Run subwatershed were targeted for Retrofit Reconnaissance Investigations. The conversion feasibility, along with subsequent potential to improve water quality, was ranked for each facility. Of the 3 ponds, 1 was ranked as High, 1 as Medium, and 1 as Low.

### *Subwatershed Management Strategy*

Figure 7-55 provides a visual summary of potential restoration opportunities in the South Fork Broad Run subwatershed.

#### Engaging Citizens and Watershed Groups

1. Conduct appropriate downspout rain barrel installation measures in neighborhoods according to Table 7-21.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 7-21.
3. Educate citizens about the benefits and importance of conservation planting and its effects on water quality for the neighborhood indicated in Table 7-21.
4. Educate property owners about improving stream buffer management at locations indicated in Table 7-21.
5. Engage institutional sites listed in Table 7-23 in tree planting and new SCMs.
6. Investigate the pervious areas described in Table 7-24 for potential tree planting.



**Figure 7-55: Preliminary Restoration Opportunities in South Fork Broad Run Subwatershed**

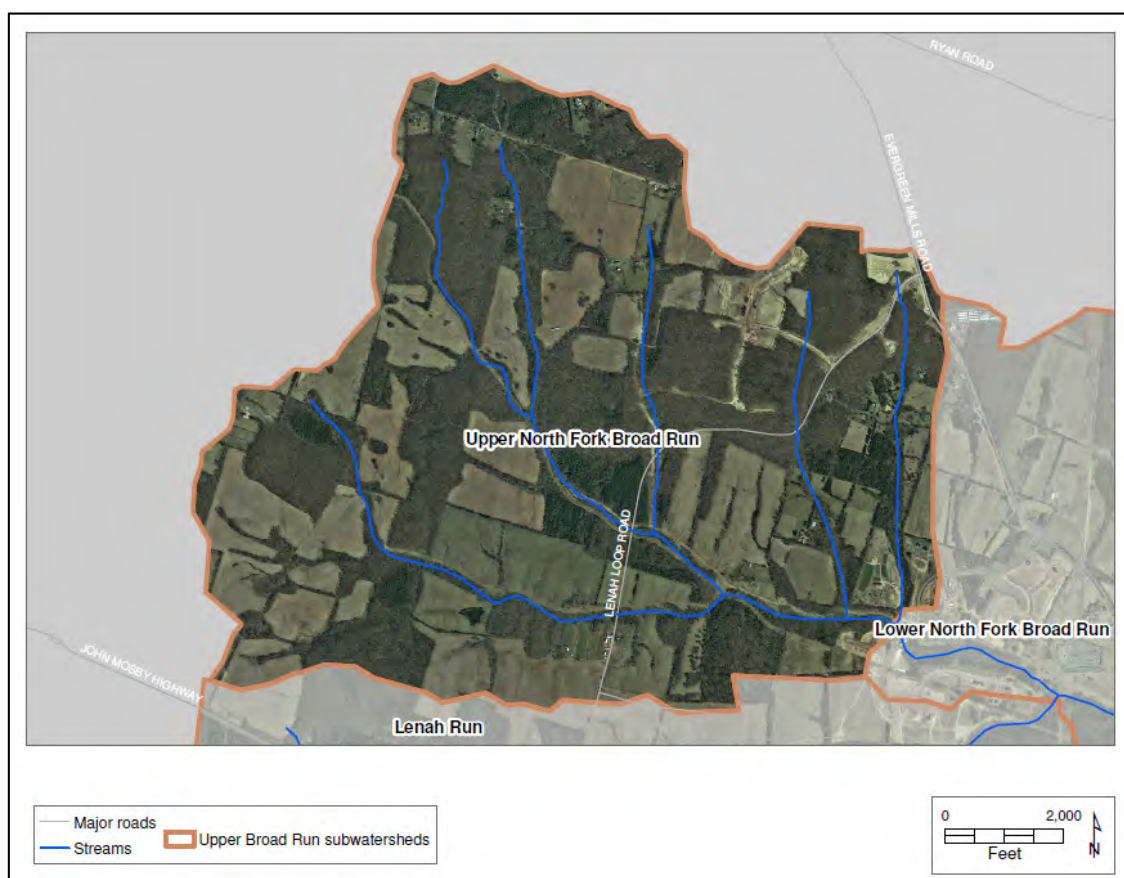
#### Municipal Actions

1. Follow-up regarding conditions at confirmed hotspot indicated in Table 7-22.
2. Educate institutions about the importance of proper trash management as listed in Table 7-23.
3. Work with the institution owners to pursue SCM opportunities at public institutions noted in Table 7-23.
4. Engage sod farmers about relocating discarded sod away from the stream channel.
5. Evaluate land preservation options (including potentially promoting the use of conservation easements) for the forested wetland areas adjacent to high quality streams, recommended for preservation by the stream corridor assessment.
6. Consider preliminary recommendations for stream restoration in areas of moderate to severe bank erosion and channel alteration, as noted during the SCA.
7. Consider enhancing the forested stream buffer in places where there are no utility conflicts.
8. Consider the eradication of bamboo stands along the stream corridor.

9. Consider upgrading the stormwater management ponds described above that were ranked High or Medium for their potential conversion to improve water quality.

## 7.7 Upper North Fork Broad Run

Upper North Fork Broad Run is the fourth largest subwatershed in the Upper Broad Run watershed. The subwatershed is mainly cropland, pasture and forest, though new residential developments are starting to appear. High quality forests and wetlands are also located in the western portion of the subwatershed, and are described in the stream corridor discussion. Figure 7-56 shows the existing conditions (as of 2012) within the subwatershed. Table 7-25 summarizes the key subwatershed characteristics of South Fork Broad Run.



**Figure 7-56: Existing Conditions – Upper North Fork Broad Run Subwatershed**

**Table 7-25: Key Characteristics – Upper North Fork Broad Run Subwatershed**

Drainage Area	2,223.9 acres (3.5 sq. mi.)	
Stream Length	8.2 miles	
Land Use/Land Cover	Barren:	0.0%
	Cropland:	26.4%
	Forest:	51.8%
	Pasture:	19.3%
	Urban Impervious:	0.2%
	Urban Pervious:	1.3%
	Water:	0.3%
	Missing:	0.6%
Impervious Cover	20.0 acres (0.9%)	
Soils	A Soils (low runoff potential):	0%
	B Soils:	5.1%
	C Soils:	14.2%
	D Soils (high runoff potential):	66.4%
	*B/D Soils:	3.3%
	*C/D Soils:	10.8%
SCMs	0% of subwatershed treated	

\*Dual Hydrologic Soil Group. See Chapter 3 for further detail.

### ***Neighborhoods***

No neighborhood source assessments were performed within the Upper North Fork Broad Run subwatershed.

### ***Hotspots***

No hotspot site investigations were performed within the Upper North Fork Broad Run subwatershed.

### ***Institutions***

No institutional site investigations were performed within the Upper North Fork Broad Run subwatershed.

### ***Pervious Areas***

No pervious area assessments were performed within the Upper North Fork Broad Run subwatershed.

### ***Stream Corridor Assessments***

Field crews walked 2.41 miles of stream (29.2% of total stream miles) within the Upper North Fork Broad Run subwatershed to identify potential water quality problems, restoration opportunities, and stream corridor preservation opportunities. This survey focused on first through second order stream reaches. A total of 32 problems were identified throughout the Upper North Fork Broad Run subwatershed. The predominant issues were erosion and inadequate buffer,

although these problems were somewhat localized. Some of the bank erosion was exacerbated by cows from an adjacent farm that had free, unfenced access to a long reach of stream. One location during the field survey exhibited an unusual condition, noted as being moderately severe (score = 3). This condition was at a foot trail crossing that is also currently used as a motor vehicle ford crossing (likely in part as an access to the adjacent sewer line ROW). Motor vehicles should be denied direct access to the stream here; a driveable bridge should be constructed, preferably with its base out of wetlands and the floodplain. In addition, cattle from adjacent farms should be denied free access to long reaches of the stream by use of appropriate fencing. Maps showing key findings of the stream corridor assessments are found in Section 4.1.

Upper North Fork Broad Run's headwater area was recommended for stream corridor preservation (Figure 7-57). This headwater stream was broken into many small, braided channels connected directly to, or only inches above, the floodplain. Little flow was present here, and almost no bank erosion existed. Most of the upper area possessed broad, forested buffers; some of the forest here was wider than 300 feet on each bank. The forested buffers possessed moderately large, second-growth deciduous trees, consisting of pin, white, and willow oaks, red maple, boxelder, and green ash. The shrub and herbaceous layers were relatively sparse, likely owing to the generally dense tree canopy, but spicebush and sensitive fern were the principal species. Several areas with particularly low topographies along the braided channels comprised forested nontidal wetlands.



**Figure 7-57: Upper North Fork Broad Run Stream Corridor Recommended for Preservation**

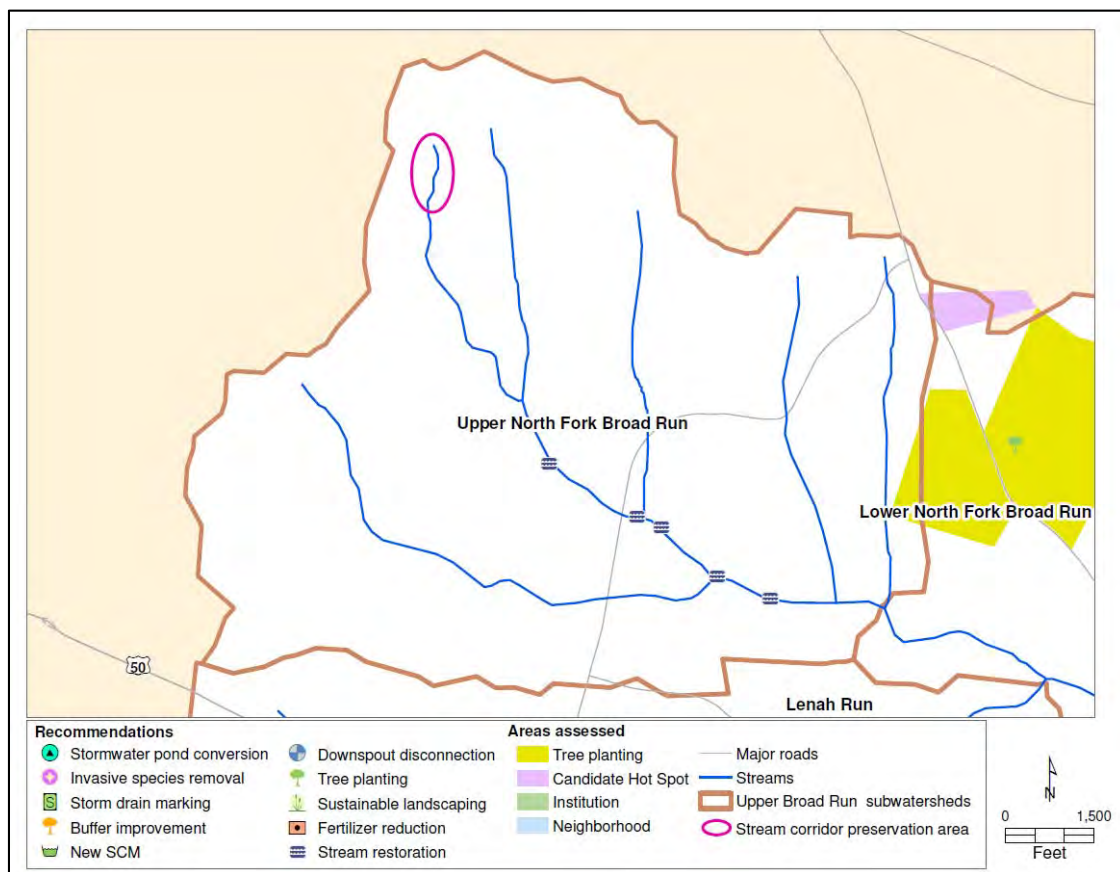
It is important that headwater areas such as these in the Upper Broad Run watershed be preserved wherever possible. Scientific evidence clearly shows that healthy headwaters are inextricably linked to the health of downstream and river ecosystems (Meyer et al. 2003). Well-buffered, undisturbed headwaters supply organic matter that contributes to the growth and productivity of higher organisms, including insects and fish. Headwaters also help to keep sediment and pollutants out of the stream system's lower reaches. In addition, they enhance biodiversity by supporting flora and fauna that are uniquely acclimated to this habitat.

### *Stormwater Conversions*

No existing stormwater management ponds were assessed within the Upper North Fork Broad Run subwatershed.

### *Subwatershed Management Strategy*

Figure 7-58 provides a visual summary of potential restoration opportunities in the Upper North Fork Broad Run subwatershed.



**Figure 7-58: Preliminary Restoration Opportunities in Upper North Fork Broad Run Subwatershed**

### Engaging Citizens and Watershed Groups

1. Engage property owners about fencing animals out of stream corridors.

### Municipal Actions

1. Evaluate land preservation options (including potentially promoting the use of conservation easements) to protect the headwater stream corridor, recommended for preservation by the stream corridor assessment.
2. Consider preliminary recommendations for stream restoration in areas of moderate to severe bank erosion and channel alteration, as noted during the SCA.
3. Educate property owners about the importance of keeping motorized vehicles out of streams; pursue alternatives to the existing stream crossing, to replace the ford with a bridge.

